FIG. 1A
A SIMPLIFIED PSK TRANSMITTER

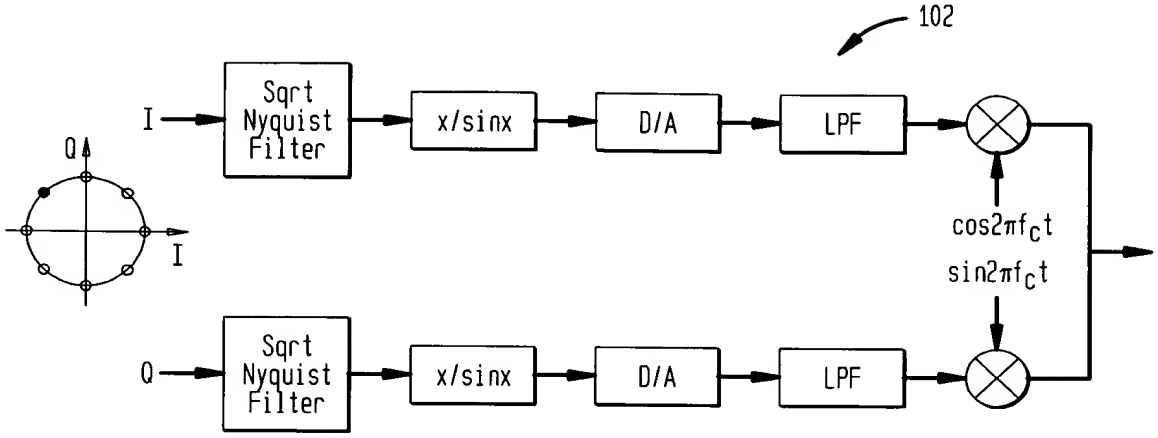
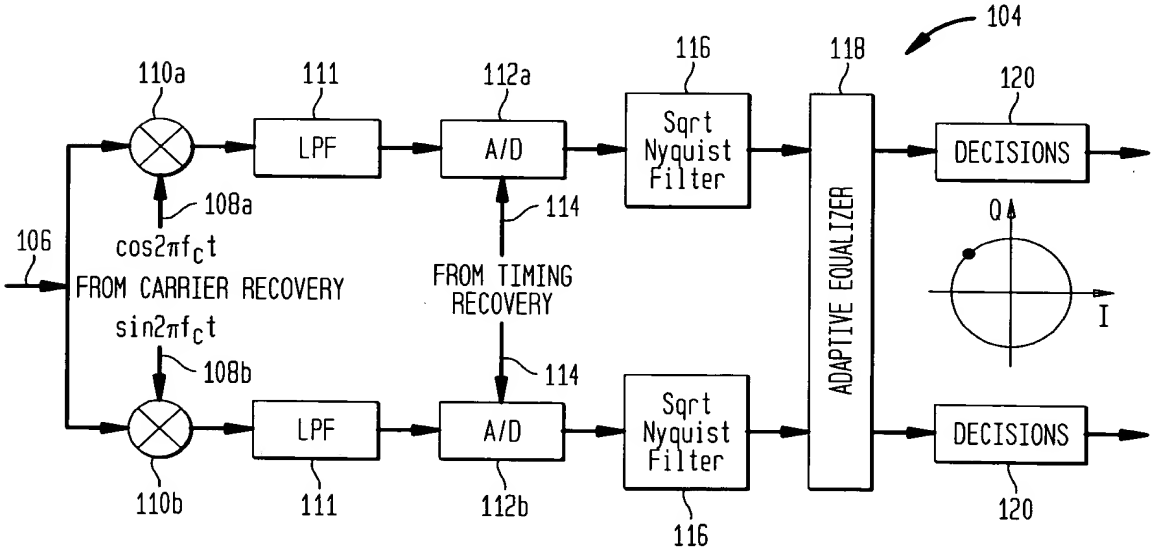


FIG. 1B
A SIMPLIFIED PSK RECEIVER



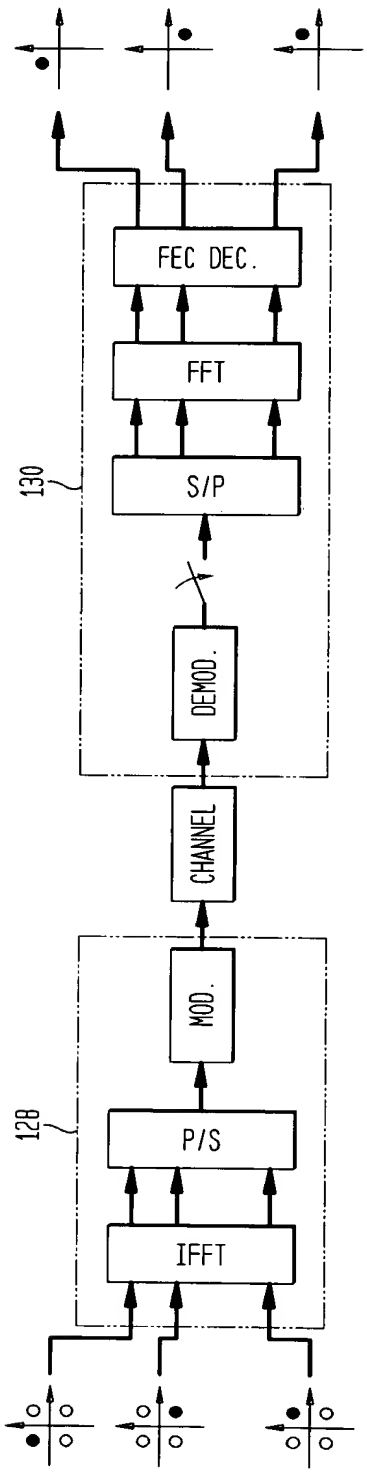


FIG. 1C
SIMPLIFIED BLOCK DIAGRAM OF AN OFDM SYSTEM

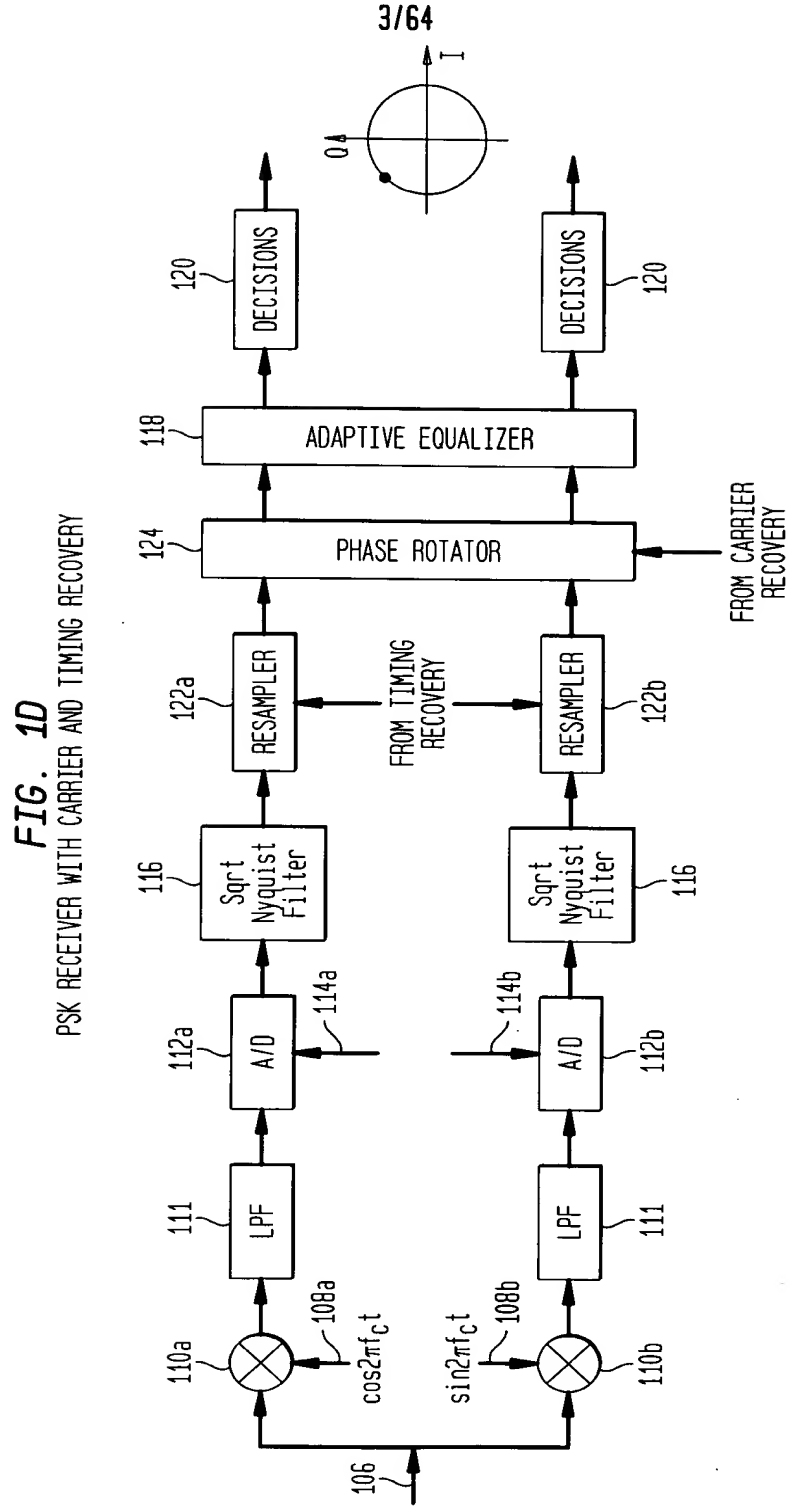


FIG. 1D
PSK RECEIVER WITH CARRIER AND TIMING RECOVERY

FIG. 2
INTERPOLATION ENVIRONMENT

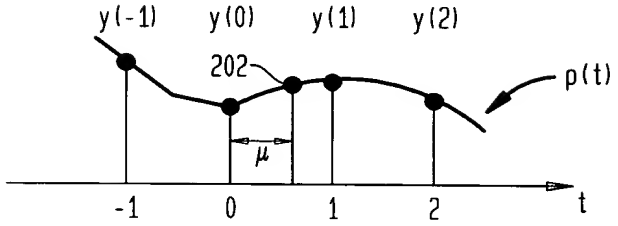
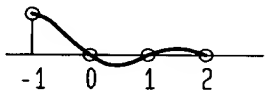
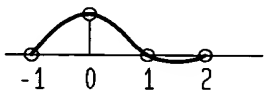


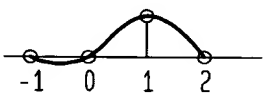
FIG. 3
THE LAGRANGE BASIS POLYNOMIALS



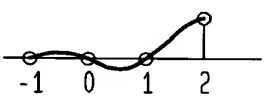
$$C_{-1}(u) = -\frac{1}{6}u^3 + \frac{1}{2}u^2 - \frac{1}{3}u$$



$$C_0(u) = \frac{1}{2}u^3 - u^2 - \frac{1}{2}u + 1$$



$$C_1(u) = -\frac{1}{2}u^3 + \frac{1}{2}u^2 + u$$



$$C_2(u) = \frac{1}{6}u^3 - \frac{1}{6}u$$

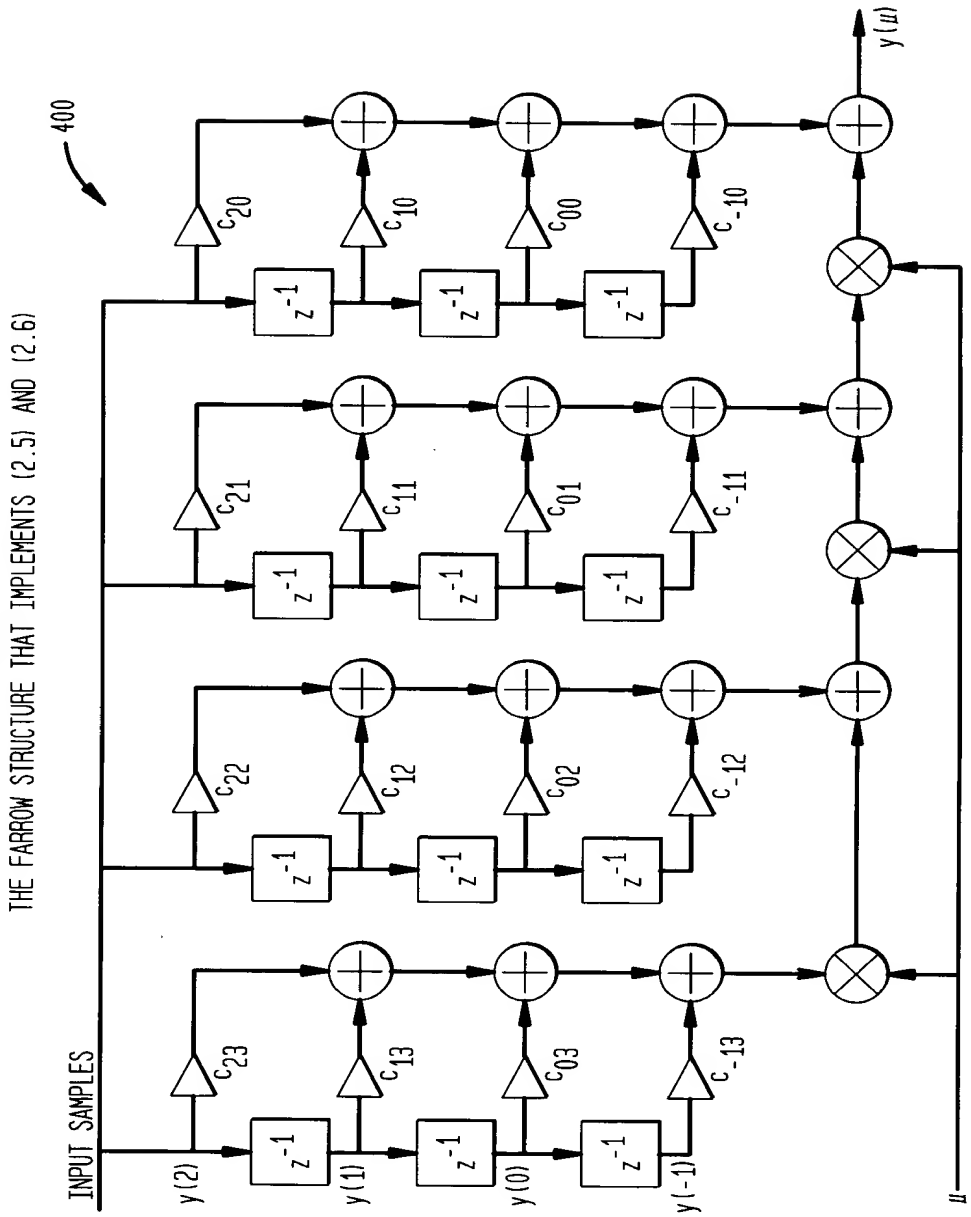


FIG. 4
THE FARROW STRUCTURE THAT IMPLEMENTS (2.5) AND (2.6)

FIG. 5

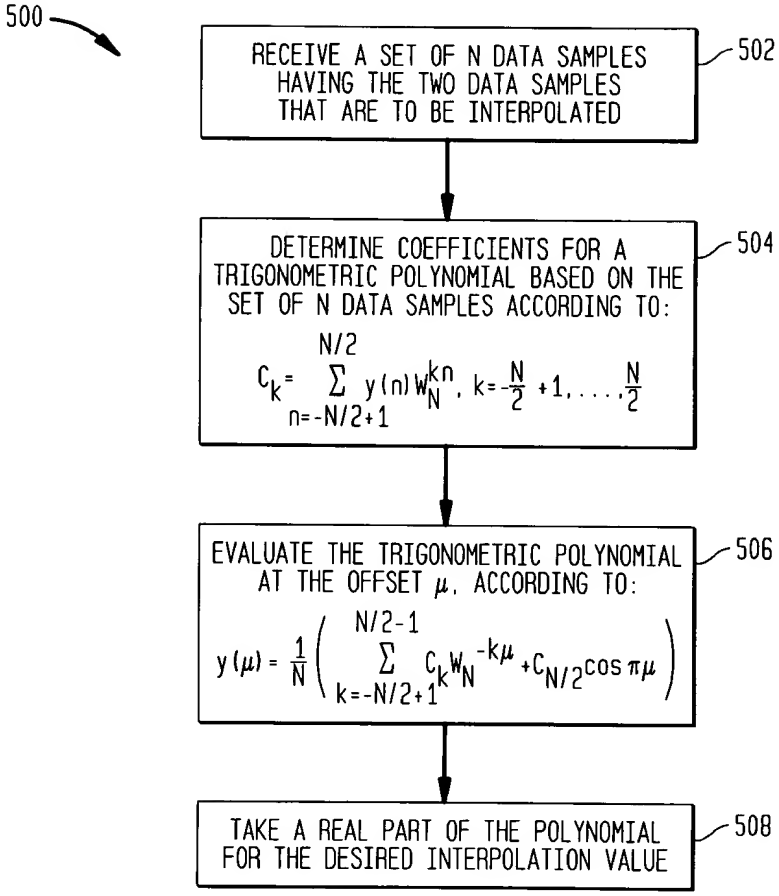

500
RECEIVE A SET OF N DATA SAMPLES HAVING THE TWO DATA SAMPLES THAT ARE TO BE INTERPOLATED
502
DETERMINE COEFFICIENTS FOR A TRIGONOMETRIC POLYNOMIAL BASED ON THE SET OF N DATA SAMPLES ACCORDING TO:
$C_k = \sum_{n=-N/2+1}^{N/2} y(n) W_N^{kn}, \; k = -\frac{N}{2}+1, \ldots, \frac{N}{2}$
504
EVALUATE THE TRIGONOMETRIC POLYNOMIAL AT THE OFFSET μ, ACCORDING TO:
$y(\mu) = \frac{1}{N}\left(\sum_{k=-N/2+1}^{N/2-1} C_k W_N^{-k\mu} + C_{N/2} \cos \pi\mu \right)$
506
TAKE A REAL PART OF THE POLYNOMIAL FOR THE DESIRED INTERPOLATION VALUE
508

FIG. 6A
IMPULSE RESPONSES OF LAGRANGE INTERPOLATOR

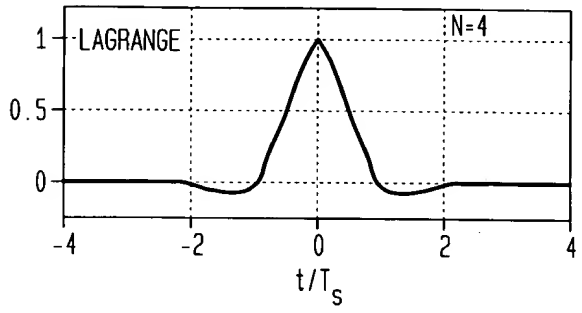


FIG. 6B
IMPULSE RESPONSES OF TRIGONOMETRIC INTERPOLATOR

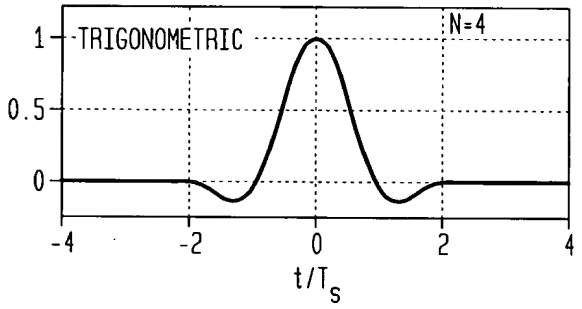


FIG. 7A
FREQUENCY RESPONSES FOR N=4

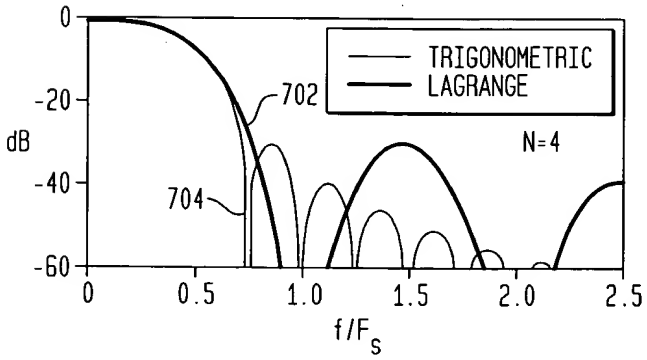


FIG. 7B

FREQUENCY RESPONSES FOR N=32

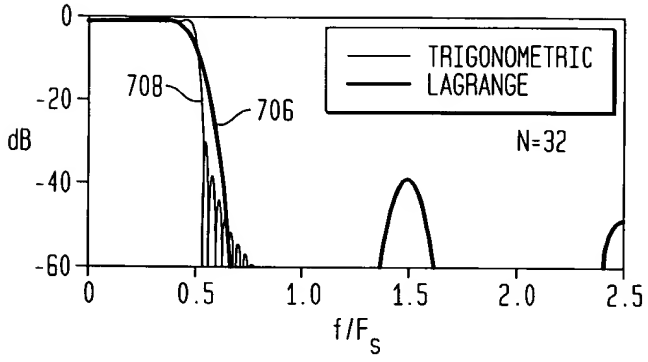


FIG. 8A

SIGNAL WITH TWO SAMPLES/SYMBOL AND 100% EXCESS BW

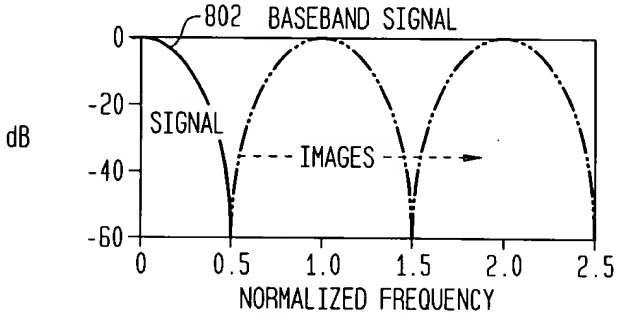
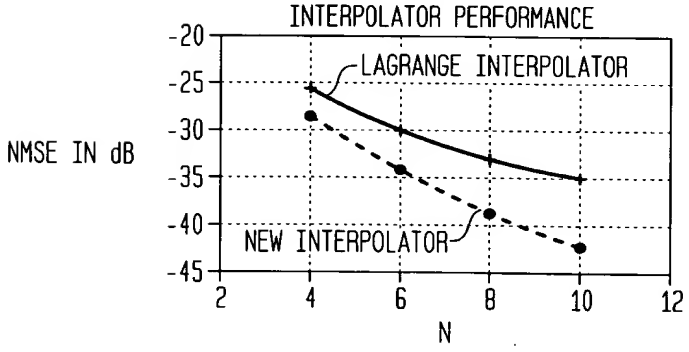


FIG. 8B

NMSE OF THE INTERPOLATED SIGNAL



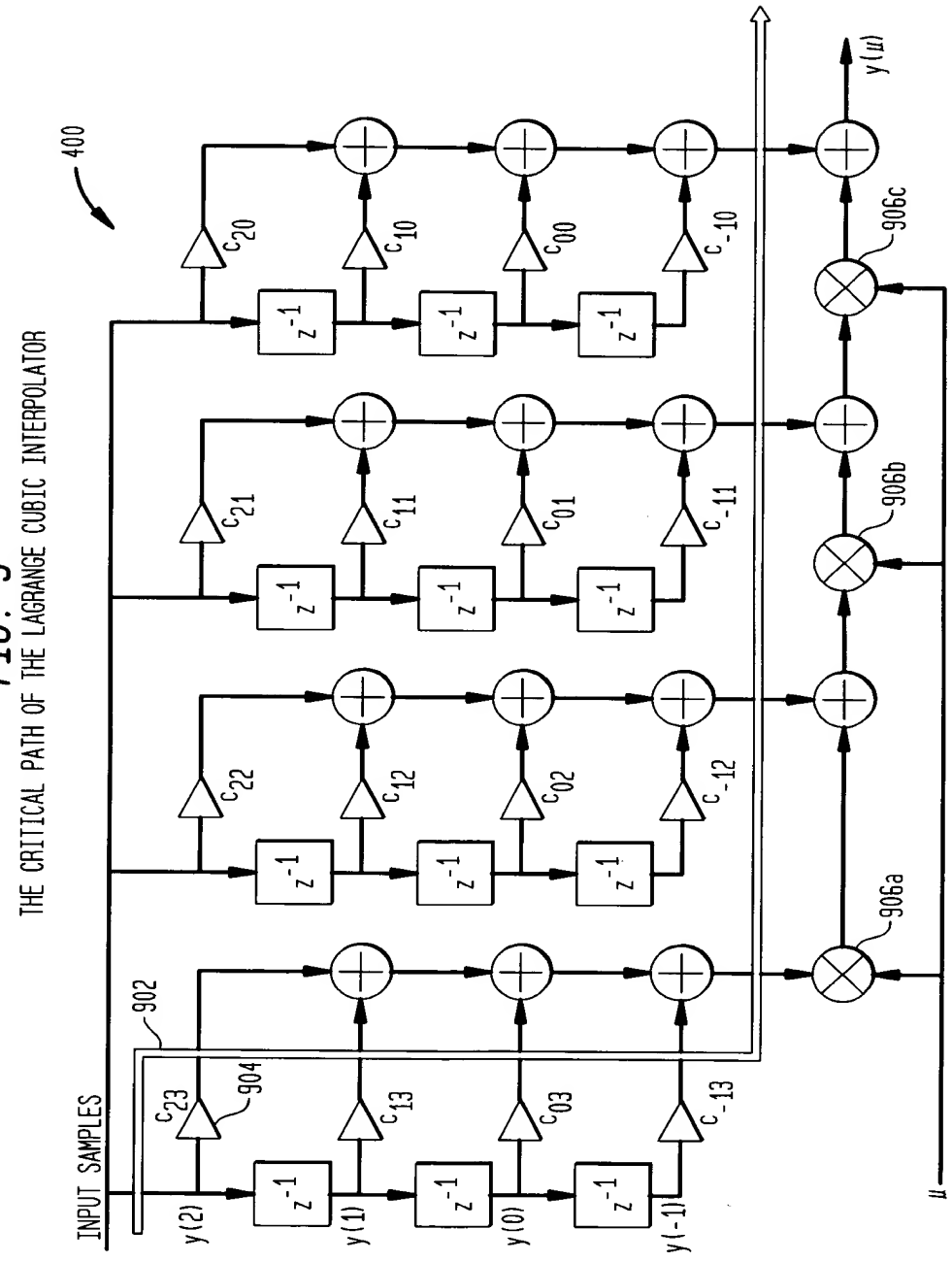


FIG. 9
THE CRITICAL PATH OF THE LAGRANGE CUBIC INTERPOLATOR

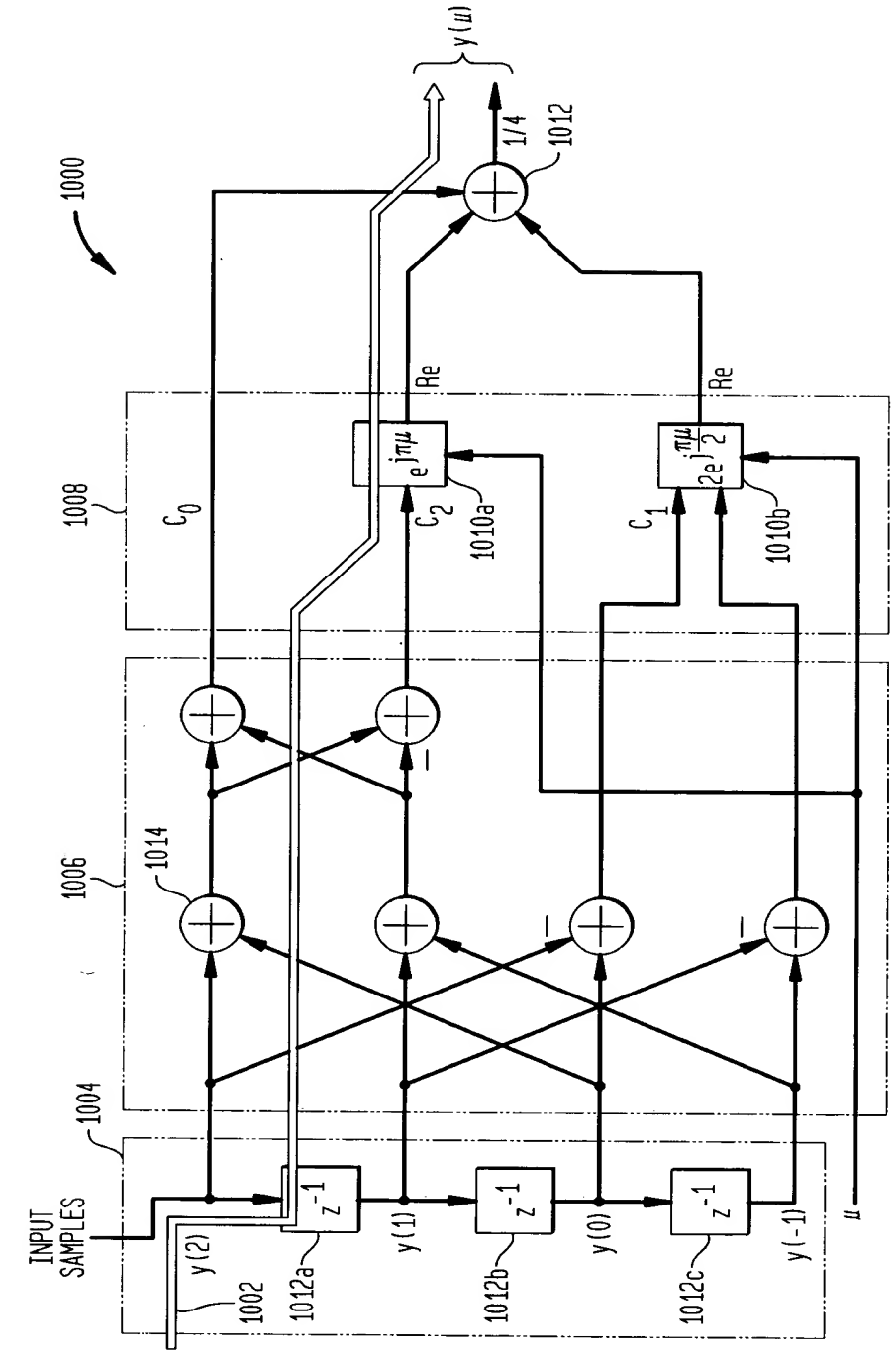


FIG. 10
TRIGONOMETRIC INTERPOLATOR (N=4)

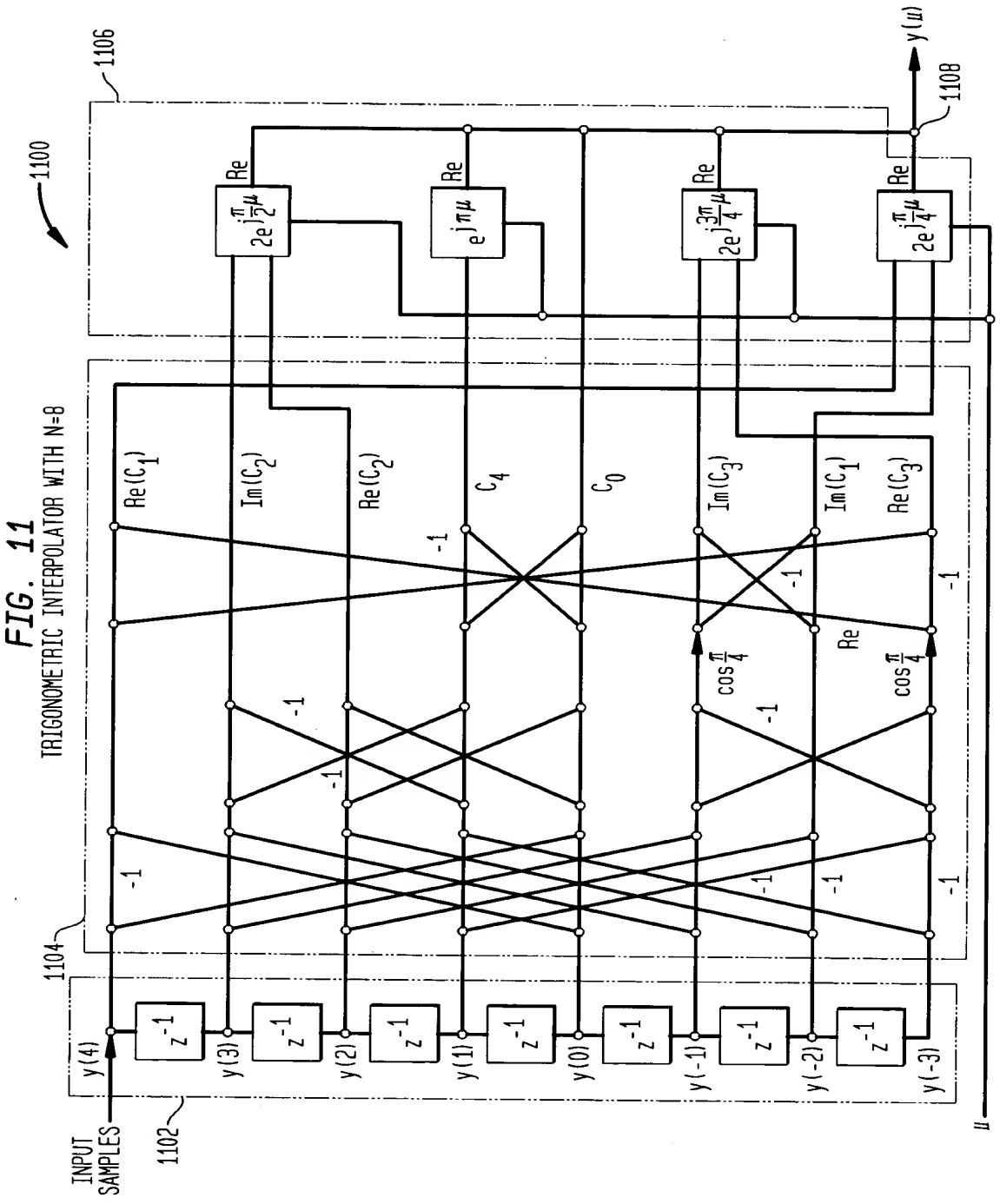


FIG. 11
TRIGONOMETRIC INTERPOLATOR WITH N=8

FIG. 12
CONCEPTUAL MODIFICATION OF INPUT SAMPLES

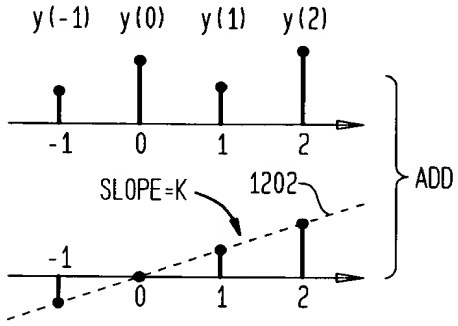
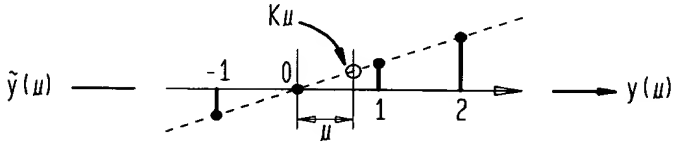


FIG. 13
CORRECTING THE OFFSET DUE TO MODIFICATION OF ORIGINAL SAMPLES



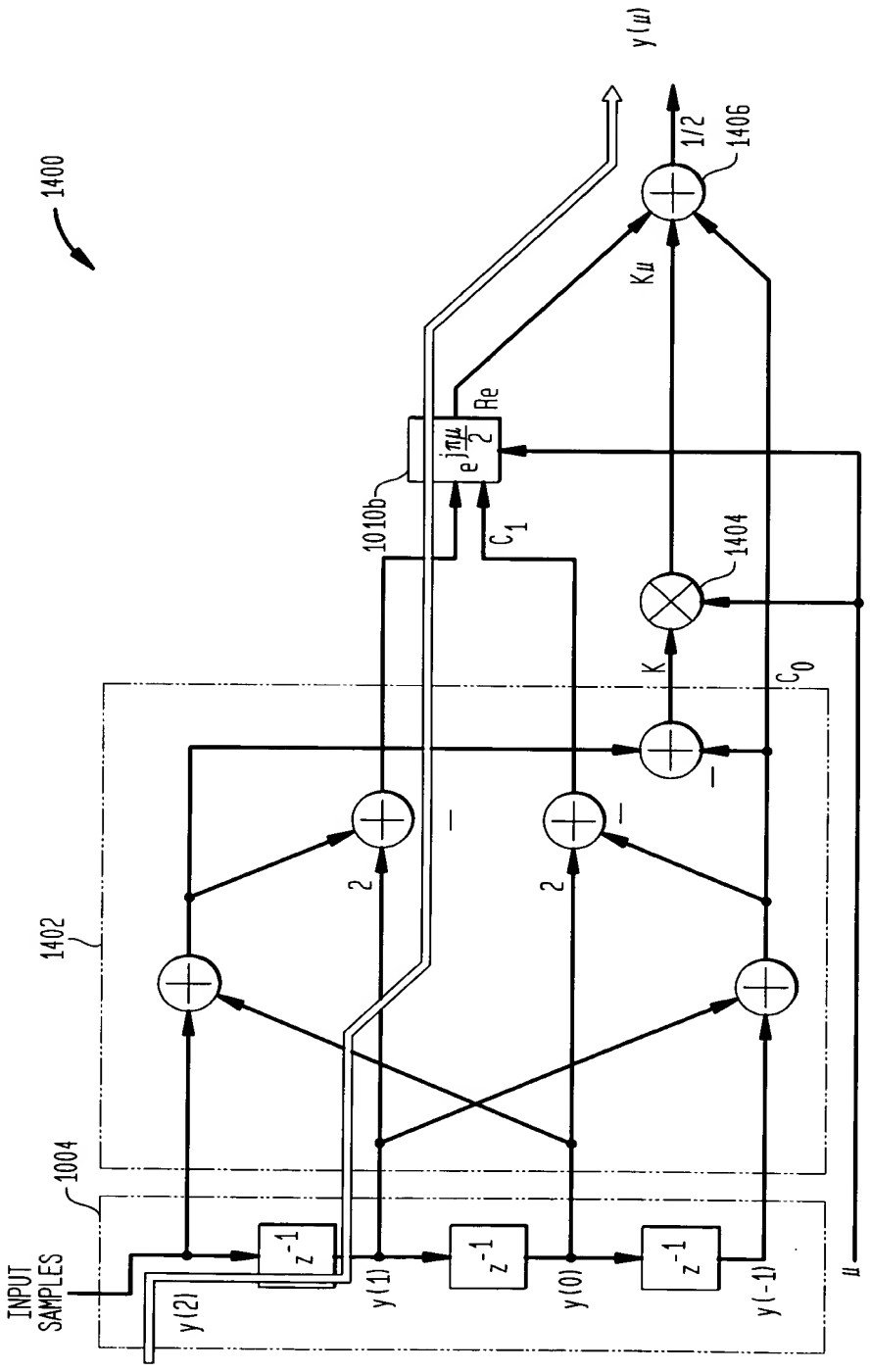


FIG. 14
TRIGONOMETRIC INTERPOLATOR N=4

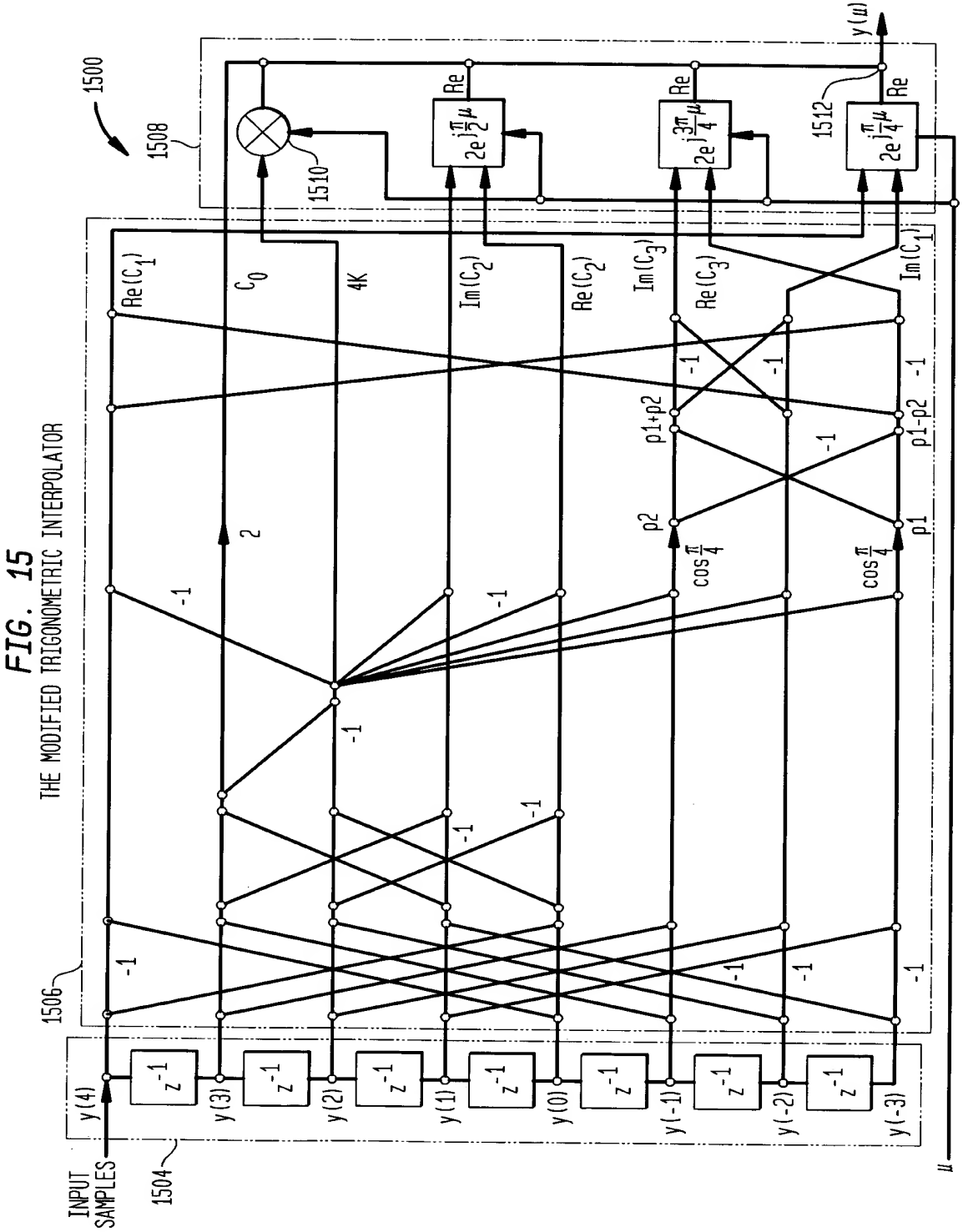


FIG. 15
THE MODIFIED TRIGONOMETRIC INTERPOLATOR

INTERPOLATION ERRORS ARE SHOWN IN HATCH

FIG. 16A
LAGRANGE CUBIC

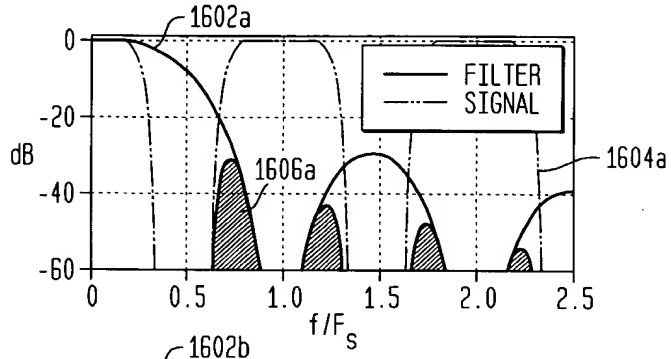


FIG. 16B
TRIGONOMETRIC INTERPOLATOR 1000
(FIG. 10)

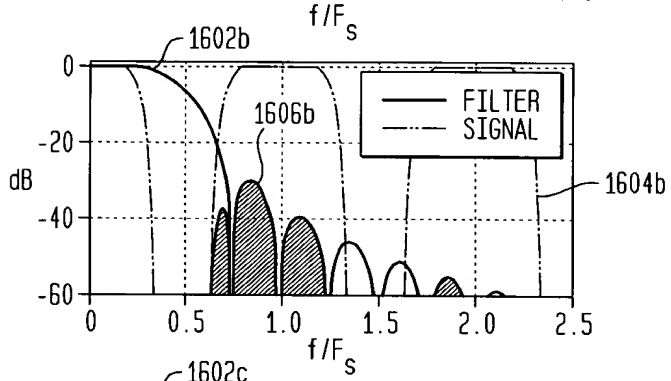


FIG. 16C
TRIGONOMETRIC INTERPOLATOR 1400
(FIG. 14)

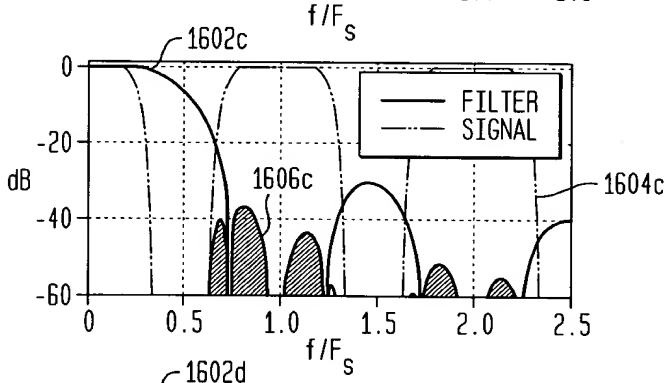


FIG. 16D
OPTIMAL STRUCTURE

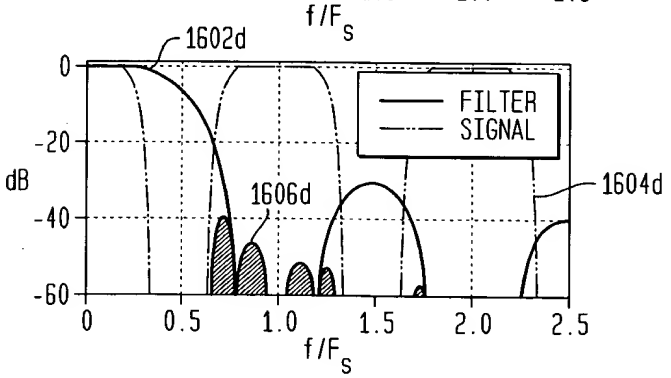


FIG. 17

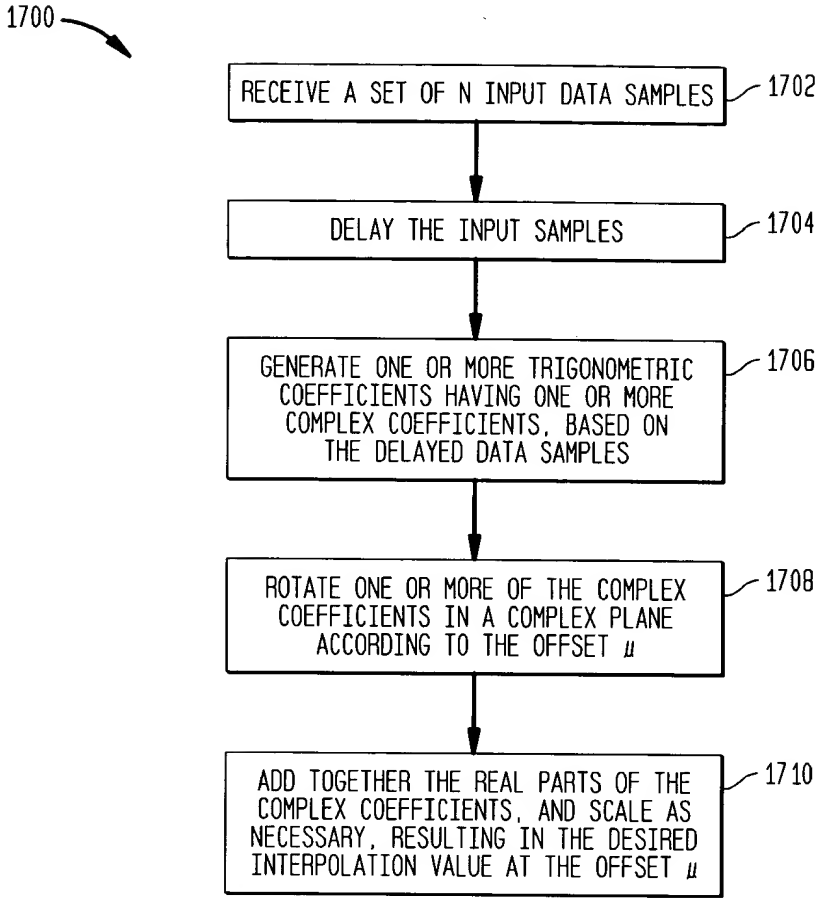

1700
RECEIVE A SET OF N INPUT DATA SAMPLES
1702
DELAY THE INPUT SAMPLES
1704
GENERATE ONE OR MORE TRIGONOMETRIC COEFFICIENTS HAVING ONE OR MORE COMPLEX COEFFICIENTS, BASED ON THE DELAYED DATA SAMPLES
1706
ROTATE ONE OR MORE OF THE COMPLEX COEFFICIENTS IN A COMPLEX PLANE ACCORDING TO THE OFFSET μ
1708
ADD TOGETHER THE REAL PARTS OF THE COMPLEX COEFFICIENTS, AND SCALE AS NECESSARY, RESULTING IN THE DESIRED INTERPOLATION VALUE AT THE OFFSET μ
1710

FIG. 18

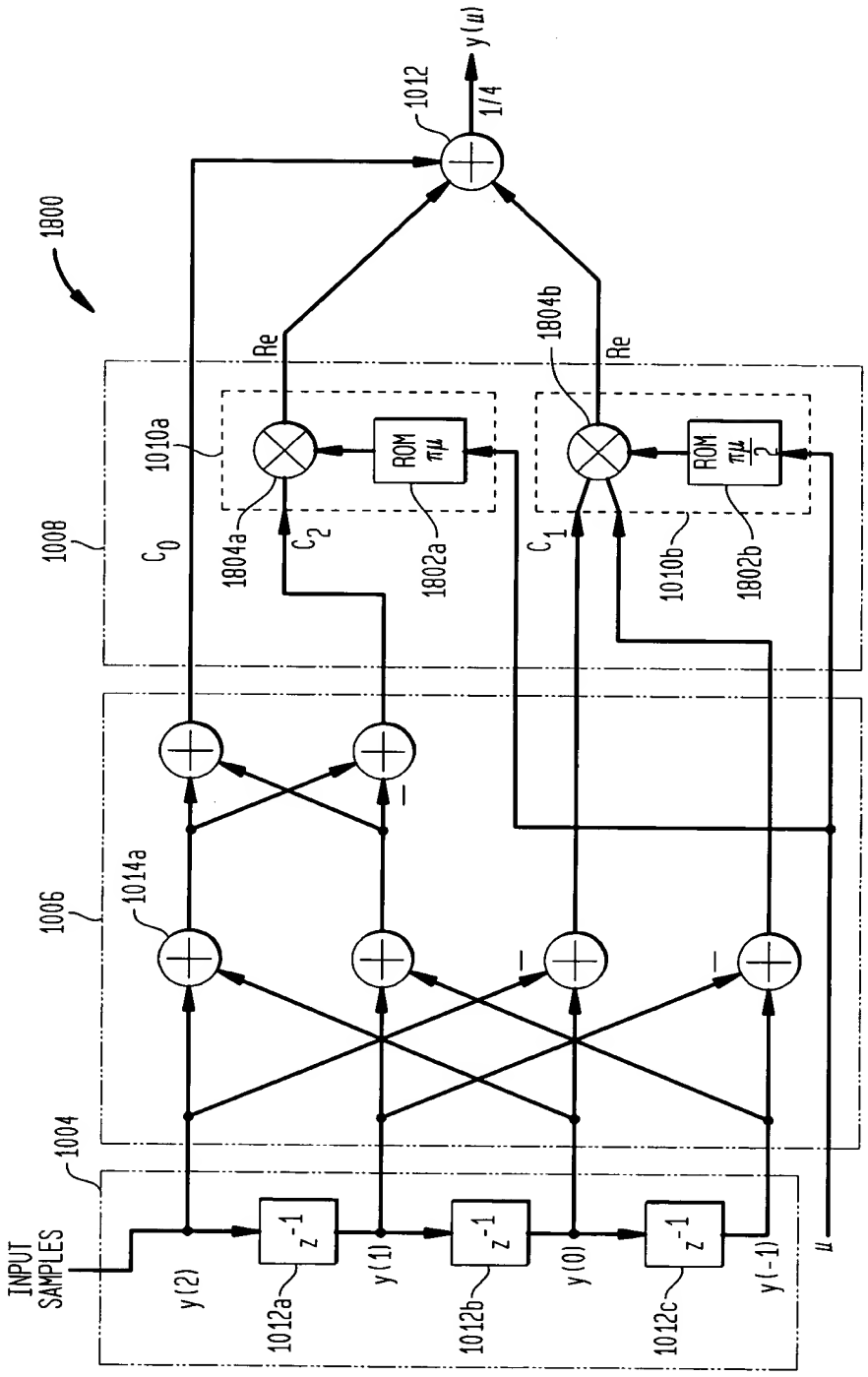

1800
1012
y(u)
1/4
Re
1804b
Re
1010a
ROM
πμ
ROM
πμ/2
1008
C0
1804a
C2
1802a
C1
1010b
1802b
1006
1014a
1004
INPUT SAMPLES
y(2)
1012a
z-1
y(1)
1012b
z-1
y(0)
1012c
z-1
y(-1)
u

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FIG. 19

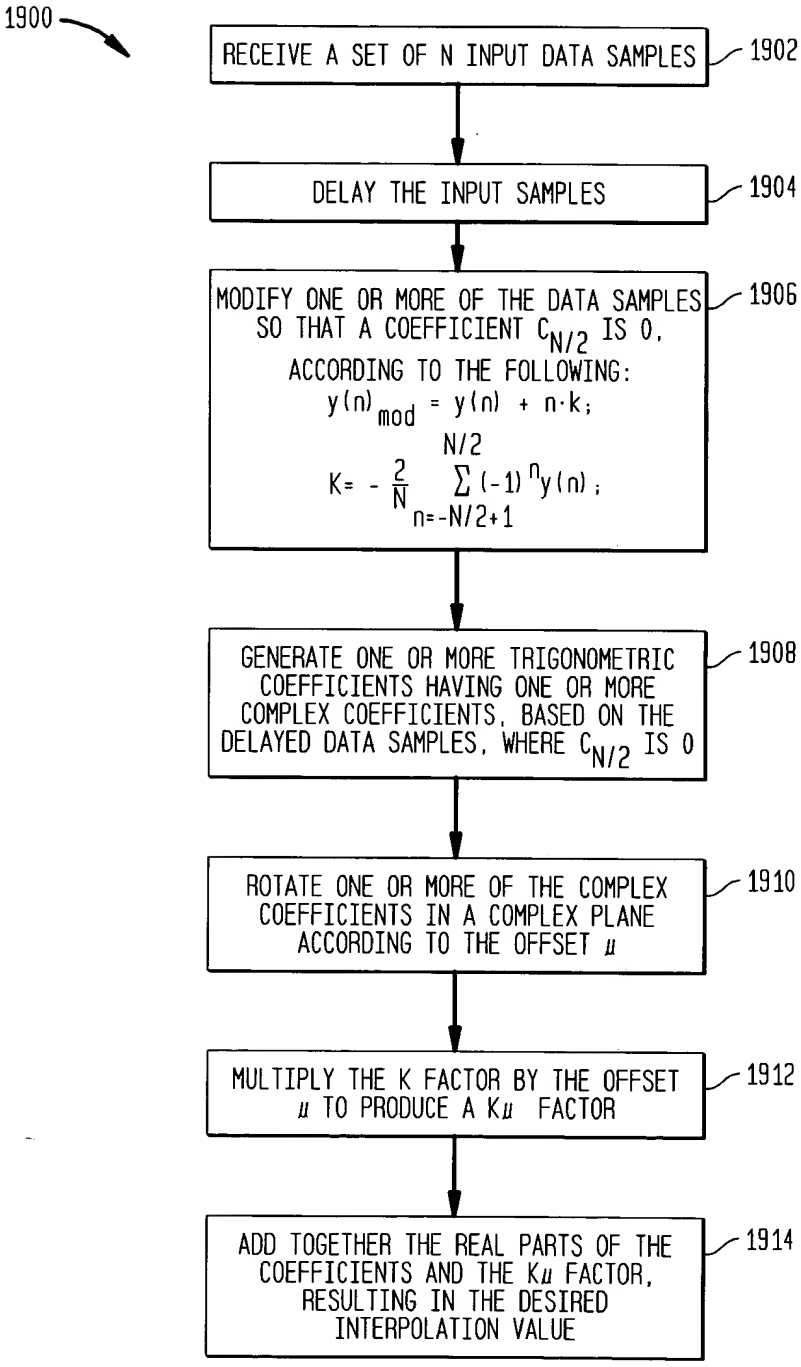
1900
RECEIVE A SET OF N INPUT DATA SAMPLES
1902
DELAY THE INPUT SAMPLES
1904
MODIFY ONE OR MORE OF THE DATA SAMPLES SO THAT A COEFFICIENT $C_{N/2}$ IS 0, ACCORDING TO THE FOLLOWING: $y(n)_{mod} = y(n) + n \cdot k$; $K = -\frac{2}{N} \sum_{n=-N/2+1}^{N/2} (-1)^n y(n)$;
1906
GENERATE ONE OR MORE TRIGONOMETRIC COEFFICIENTS HAVING ONE OR MORE COMPLEX COEFFICIENTS, BASED ON THE DELAYED DATA SAMPLES, WHERE $C_{N/2}$ IS 0
1908
ROTATE ONE OR MORE OF THE COMPLEX COEFFICIENTS IN A COMPLEX PLANE ACCORDING TO THE OFFSET μ
1910
MULTIPLY THE K FACTOR BY THE OFFSET μ TO PRODUCE A $K\mu$ FACTOR
1912
ADD TOGETHER THE REAL PARTS OF THE COEFFICIENTS AND THE $K\mu$ FACTOR, RESULTING IN THE DESIRED INTERPOLATION VALUE
1914

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FIG. 20A

NORMALIZED IMPULSE RESPONSES
f OF THE INTERPOLATION FILTERS

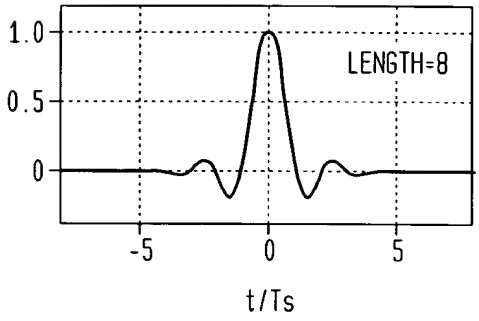

FIG. 20B

NORMALIZED IMPULSE RESPONSES
f OF THE INTERPOLATION FILTERS

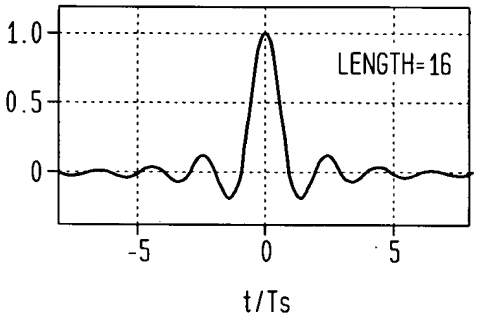

FIG. 21A

NORMALIZED FREQUENCY RESPONSES
F OF THE INTERPOLATION FILTERS

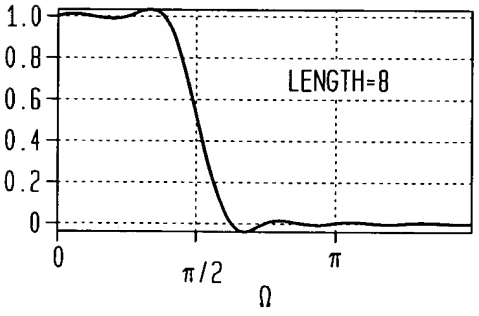

FIG. 21B

NORMALIZED FREQUENCY RESPONSES
F OF THE INTERPOLATION FILTERS

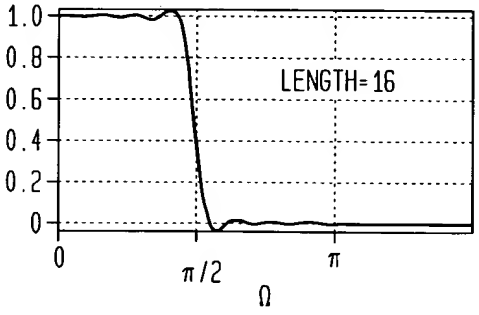

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FIG. 22

ANALYSIS OF THE FREQUENCY RESPONSES

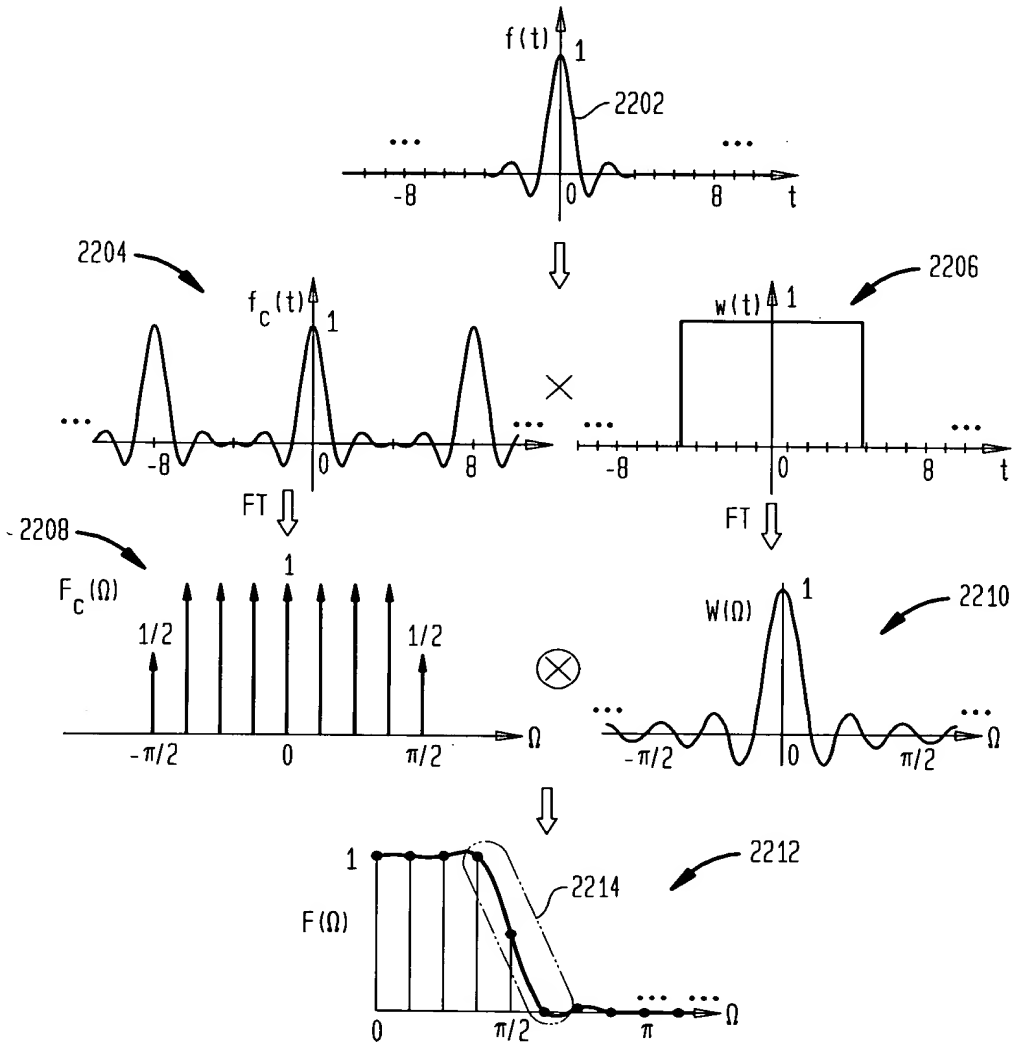

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FIG. 23A
EFFECT OF A MORE GRADUAL TRANSITION AT THE BAND EDGE

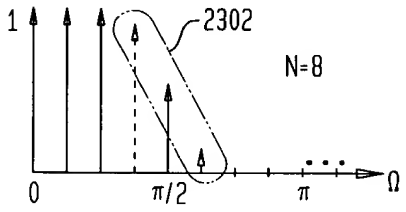

FIG. 23B
EFFECT OF A MORE GRADUAL TRANSITION AT THE BAND EDGE

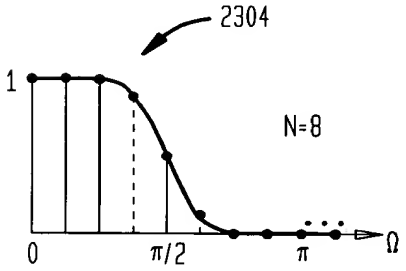

FIG. 24
REDUCING THE TRANSITION BANDWIDTH BY INCREASING N

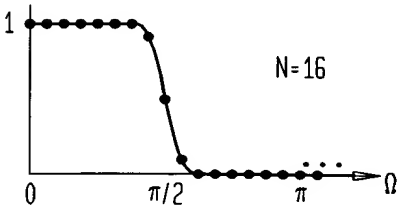

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FIG. 25A
IMPULSE RESPONSE OF THE ORIGINAL FILTER AND THE MODIFIED FILTER

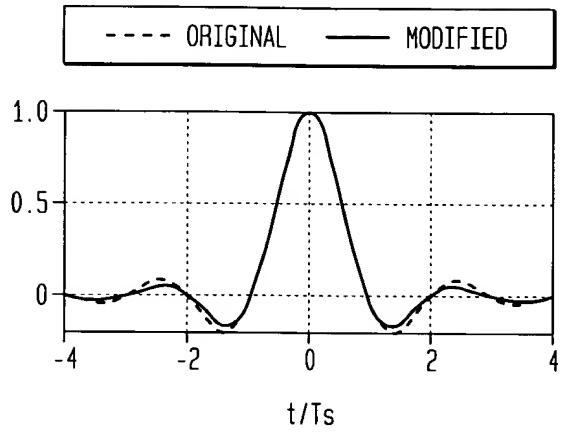

FIG. 25B
THE EQUIVALENT WINDOW

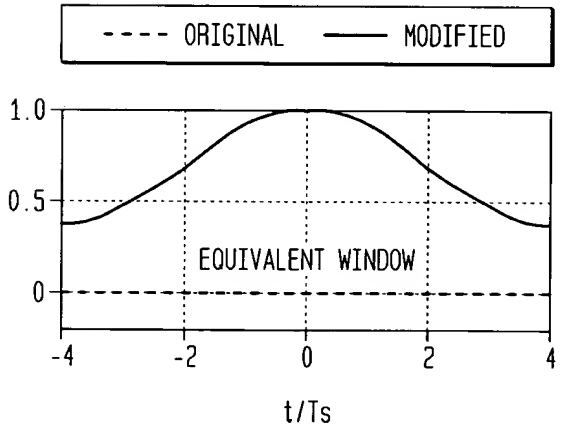

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FIG. 26

FORMING THE FREQUENCY RESPONSE OF THE DISCRETE-TIME FRACTIONAL-DELAY FILTER

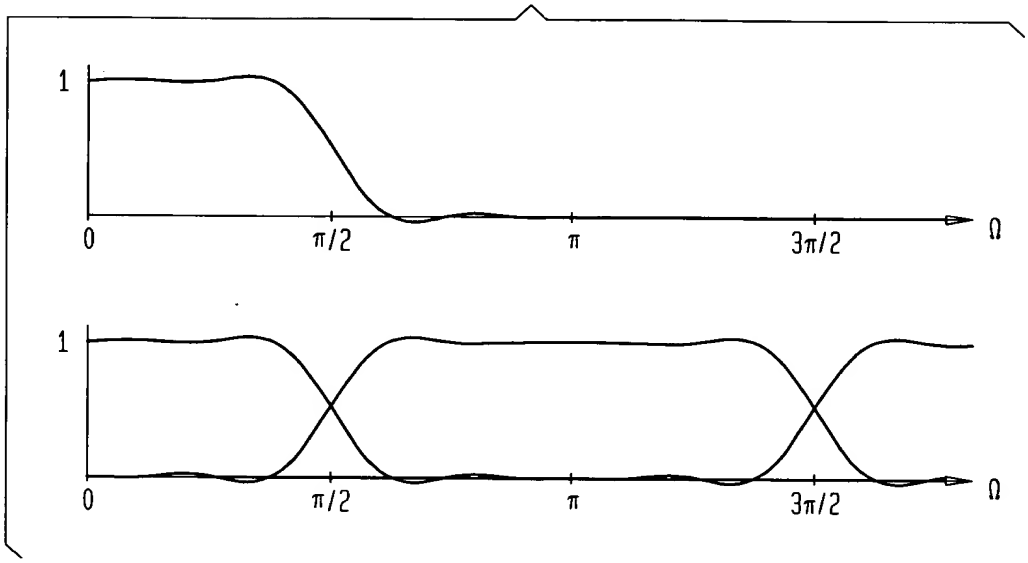

FIG. 27A

FRACTIONAL-DELAY FILTER WITH μ=0.12, USING THE PRELIMINARY N=8 INTERPOLATOR

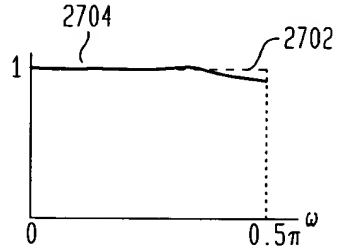

FIG. 27B

FRACTIONAL-DELAY FILTER WITH μ=0.5, USING THE PRELIMINARY N-8 INTERPOLATOR

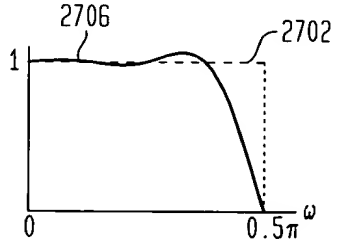

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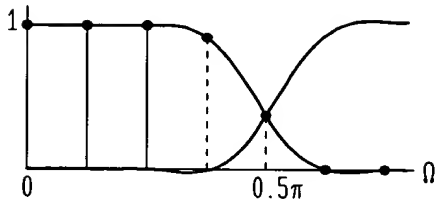
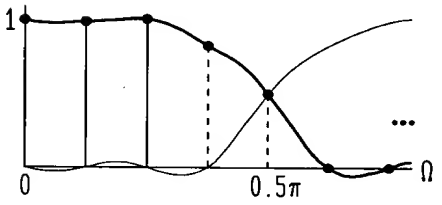
FIG. 28A



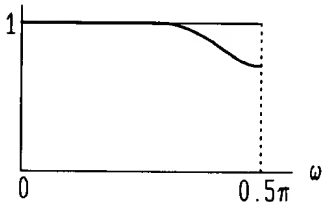
μ=0.12

FIG. 28B



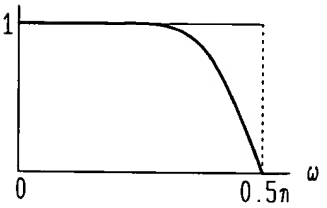
μ=0.5

FIG. 28C



μ=0.12

FIG. 28D



μ=0.5

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FIG. 29A

$F_{\mu}(\omega)$, WITH μ=0.5, N=8, BEFORE OPTIMIZATION

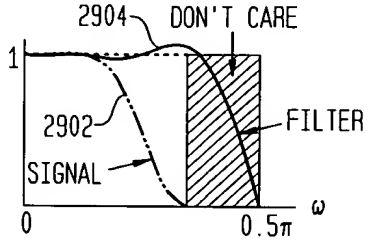

FIG. 29B

$F_{\mu}(\omega)$, WITH μ=0.5, N=8, AFTER OPTIMIZATION

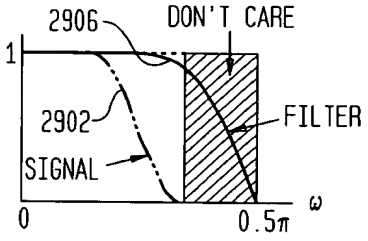

FIG. 30A

$F_{\mu}(\omega)$, WITH μ=0.5, N=4, BEFORE MODIFICATION

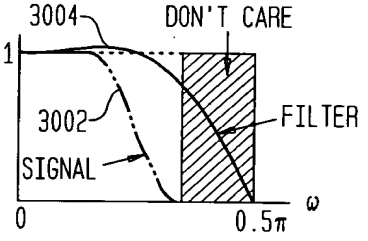

FIG. 30B

$F_{\mu}(\omega)$, WITH μ=0.5, N=4, AFTER MODIFICATION

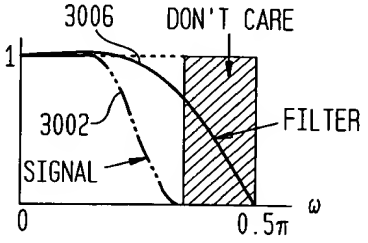

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FIG. 31A

$F_\mu(\omega)$, μ=0.5, SIMPLIFIED N=4 STRUCTURE BEFORE MODIFICATION

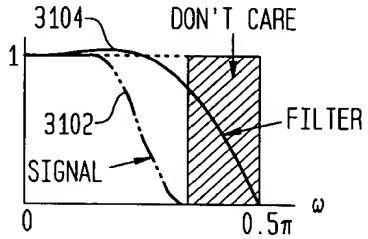

FIG. 31B

$F_\mu(\omega)$, μ=0.5, SIMPLIFIED N=4 STRUCTURE AFTER MODIFICATION

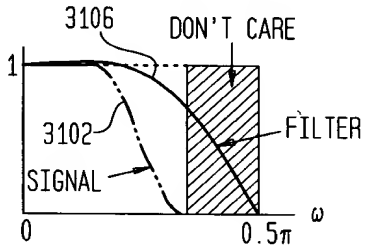

FIG. 32

REAL AND IMAGINARY COMPONENTS OF THE $F_\mu(1)e^{j\frac{\pi}{2}\mu}$ VALUE

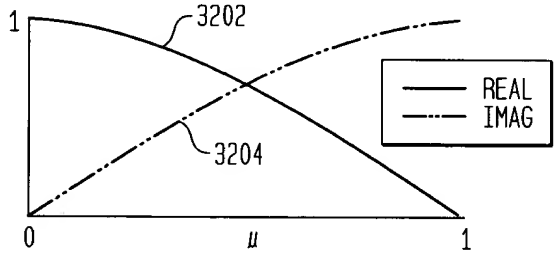

FIG. 33

SIGNAL WITH TWO SAMPLES/SYMBOL AND 40% EXCESS BANDWIDTH

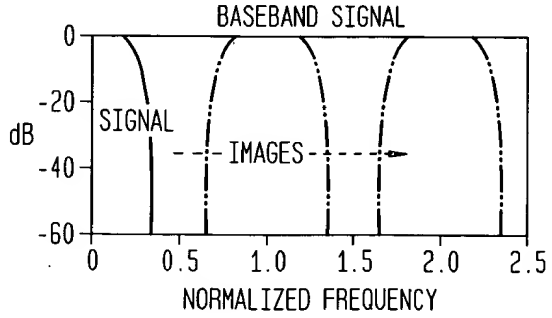

FIG. 34

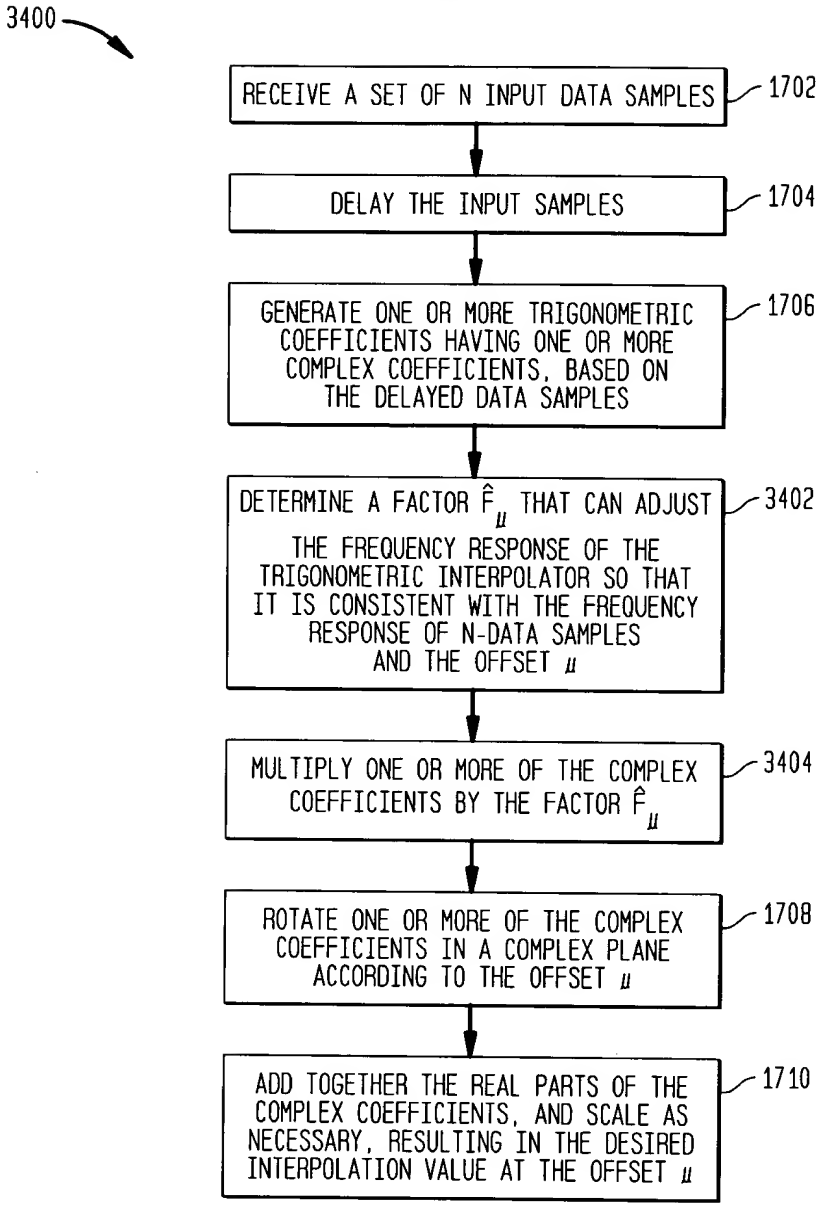
3400
RECEIVE A SET OF N INPUT DATA SAMPLES
1702
DELAY THE INPUT SAMPLES
1704
GENERATE ONE OR MORE TRIGONOMETRIC COEFFICIENTS HAVING ONE OR MORE COMPLEX COEFFICIENTS, BASED ON THE DELAYED DATA SAMPLES
1706
DETERMINE A FACTOR $\hat{F}_{\mu}$ THAT CAN ADJUST THE FREQUENCY RESPONSE OF THE TRIGONOMETRIC INTERPOLATOR SO THAT IT IS CONSISTENT WITH THE FREQUENCY RESPONSE OF N-DATA SAMPLES AND THE OFFSET μ
3402
MULTIPLY ONE OR MORE OF THE COMPLEX COEFFICIENTS BY THE FACTOR $\hat{F}_{\mu}$
3404
ROTATE ONE OR MORE OF THE COMPLEX COEFFICIENTS IN A COMPLEX PLANE ACCORDING TO THE OFFSET μ
1708
ADD TOGETHER THE REAL PARTS OF THE COMPLEX COEFFICIENTS, AND SCALE AS NECESSARY, RESULTING IN THE DESIRED INTERPOLATION VALUE AT THE OFFSET μ
1710

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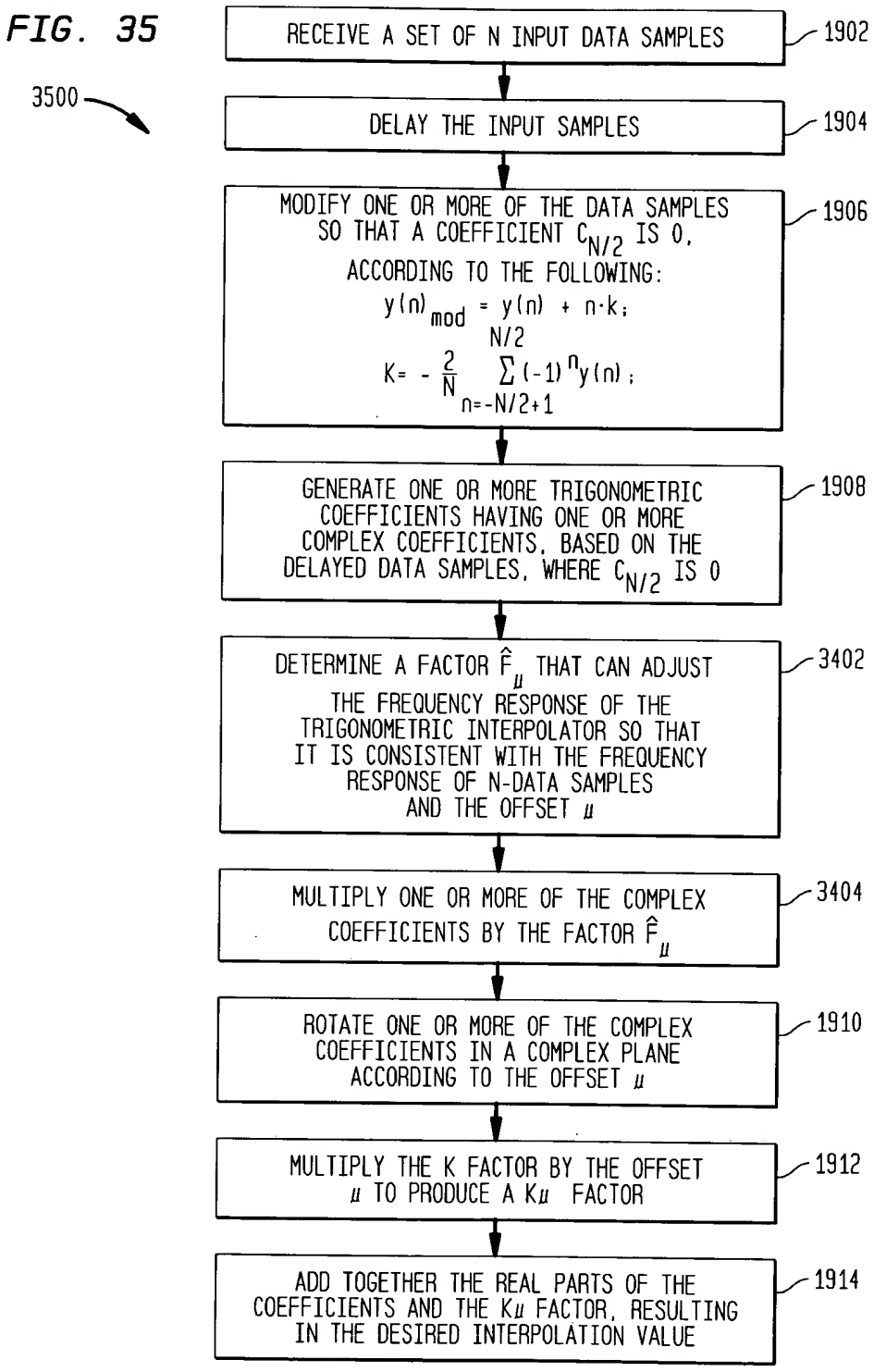
FIG. 35


3500
RECEIVE A SET OF N INPUT DATA SAMPLES
1902
DELAY THE INPUT SAMPLES
1904
MODIFY ONE OR MORE OF THE DATA SAMPLES SO THAT A COEFFICIENT $C_{N/2}$ IS 0, ACCORDING TO THE FOLLOWING:
$y(n)_{mod} = y(n) + n \cdot k;$
$K = -\frac{2}{N} \sum_{n=-N/2+1}^{N/2} (-1)^n y(n);$
1906
GENERATE ONE OR MORE TRIGONOMETRIC COEFFICIENTS HAVING ONE OR MORE COMPLEX COEFFICIENTS, BASED ON THE DELAYED DATA SAMPLES, WHERE $C_{N/2}$ IS 0
1908
DETERMINE A FACTOR $\hat{F}_\mu$ THAT CAN ADJUST THE FREQUENCY RESPONSE OF THE TRIGONOMETRIC INTERPOLATOR SO THAT IT IS CONSISTENT WITH THE FREQUENCY RESPONSE OF N-DATA SAMPLES AND THE OFFSET μ
3402
MULTIPLY ONE OR MORE OF THE COMPLEX COEFFICIENTS BY THE FACTOR $\hat{F}_\mu$
3404
ROTATE ONE OR MORE OF THE COMPLEX COEFFICIENTS IN A COMPLEX PLANE ACCORDING TO THE OFFSET μ
1910
MULTIPLY THE K FACTOR BY THE OFFSET μ TO PRODUCE A $K\mu$ FACTOR
1912
ADD TOGETHER THE REAL PARTS OF THE COEFFICIENTS AND THE $K\mu$ FACTOR, RESULTING IN THE DESIRED INTERPOLATION VALUE
1914

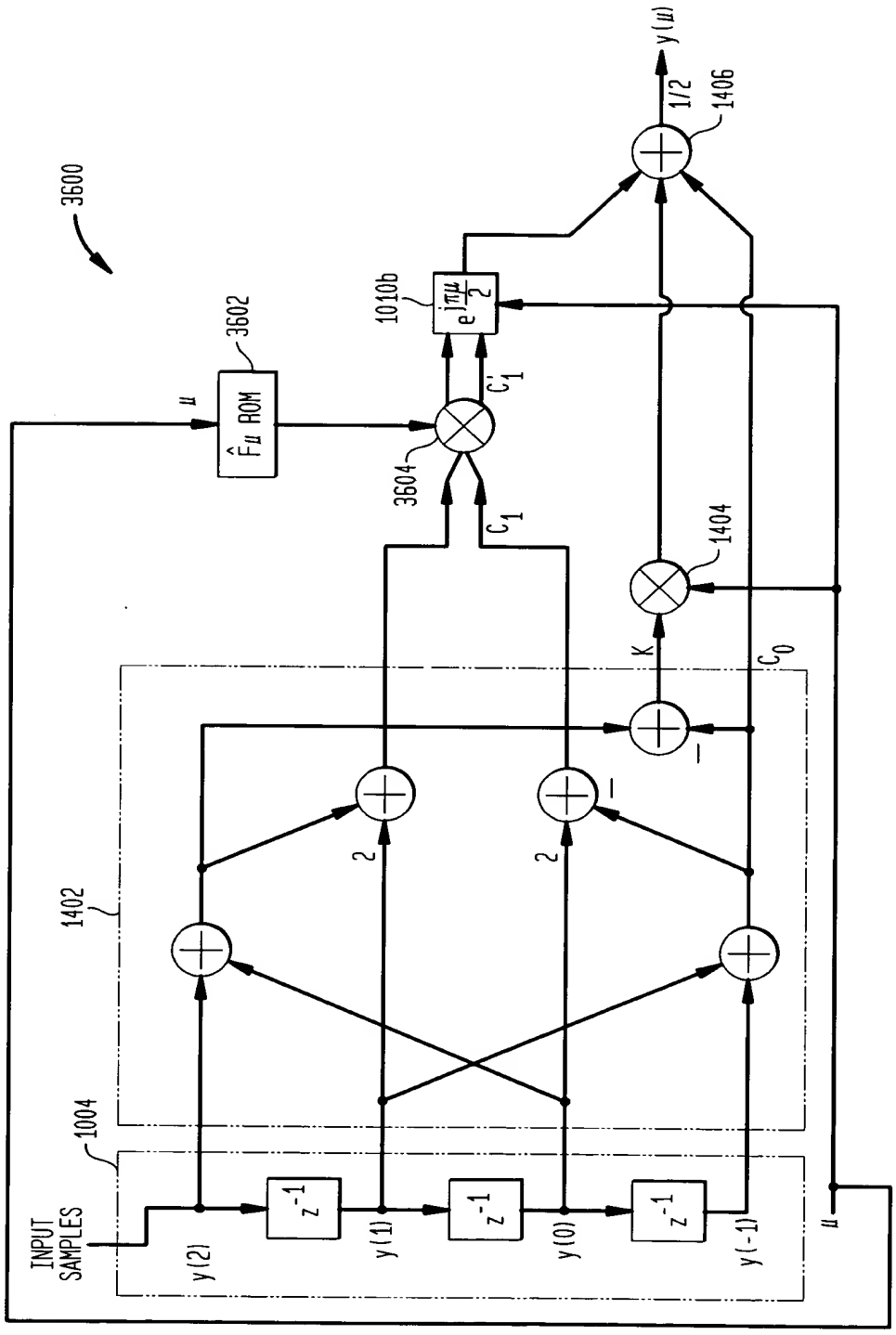


FIG. 36
THE OPTIMIZED STRUCTURE FOR N=4

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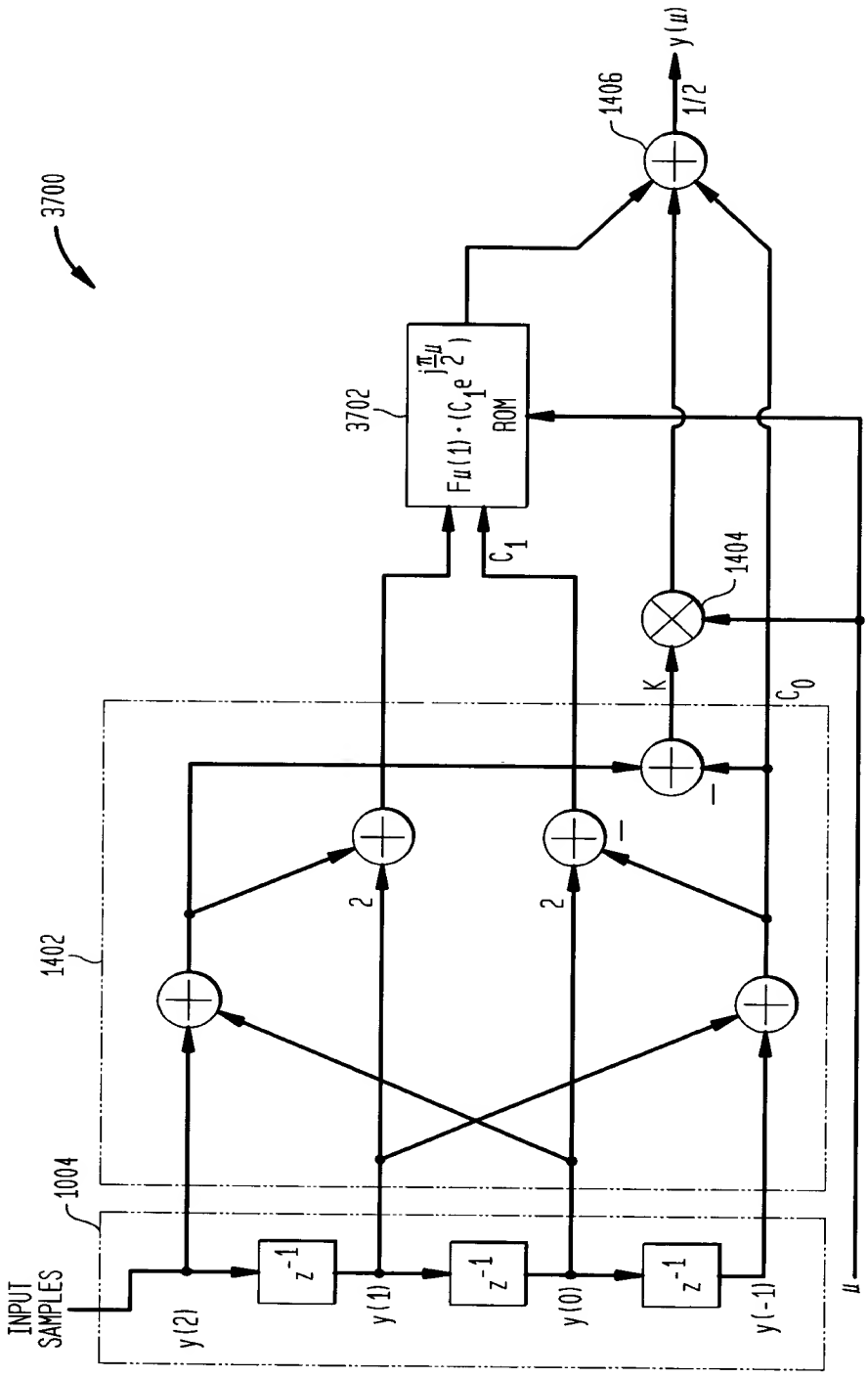

FIG. 37
THE OPTIMIZED STRUCTURE FOR N=4

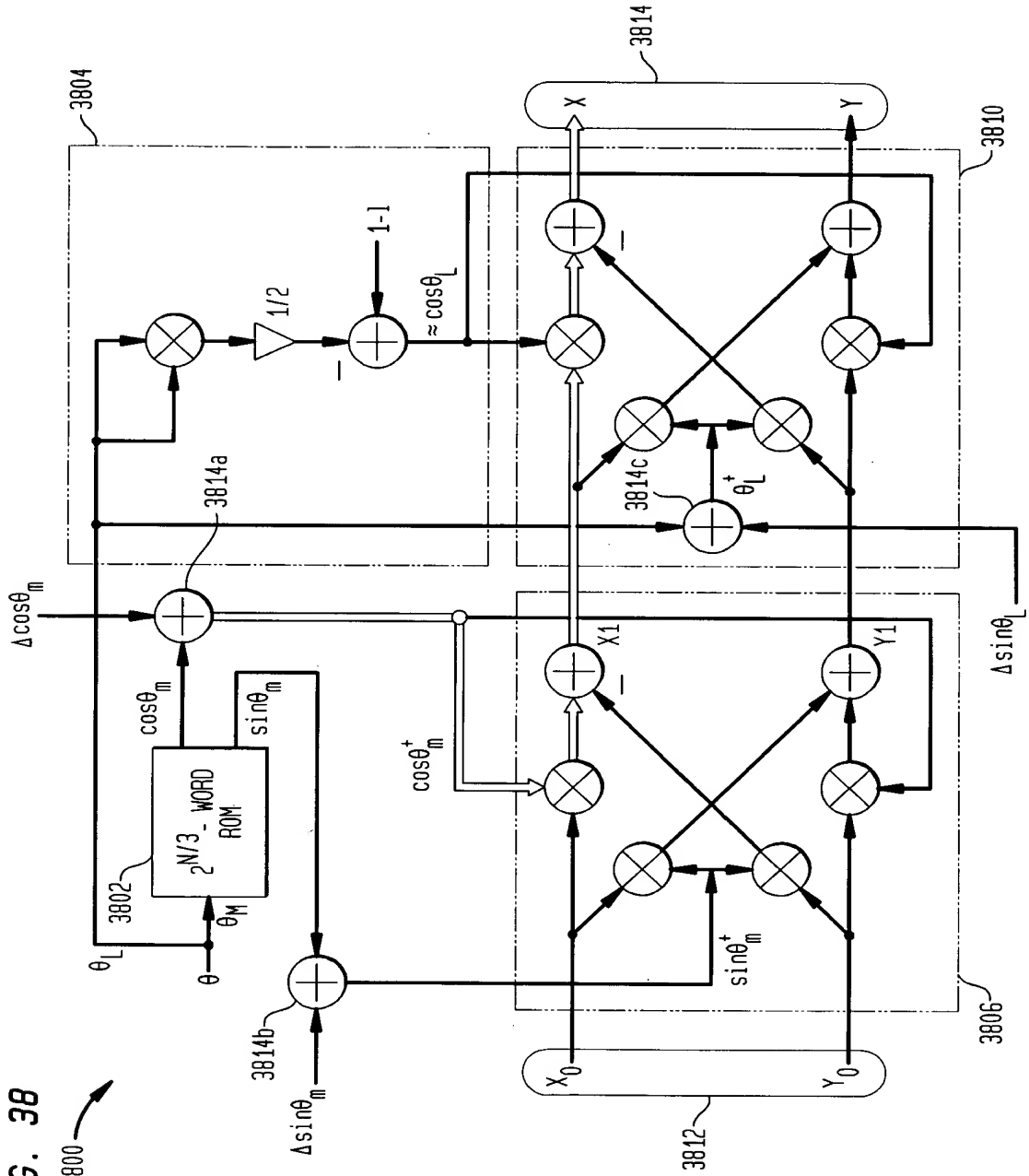
3800
3804
3814
3810
3806
3812
3802
3814a
3814b
3814c
X
Y
X1
Y1
X_0
Y_0
1-1
1/2
$\approx \cos\theta_L$
$\Delta\cos\theta_m$
$\Delta\sin\theta_m$
$\Delta\sin\theta_L$
$\cos\theta_m$
$\sin\theta_m$
$\cos\theta_m^+$
$\sin\theta_m^+$
θ_L^+
θ_L
θ_M
θ
$2^{N/3}$ - WORD ROM

FIG. 38

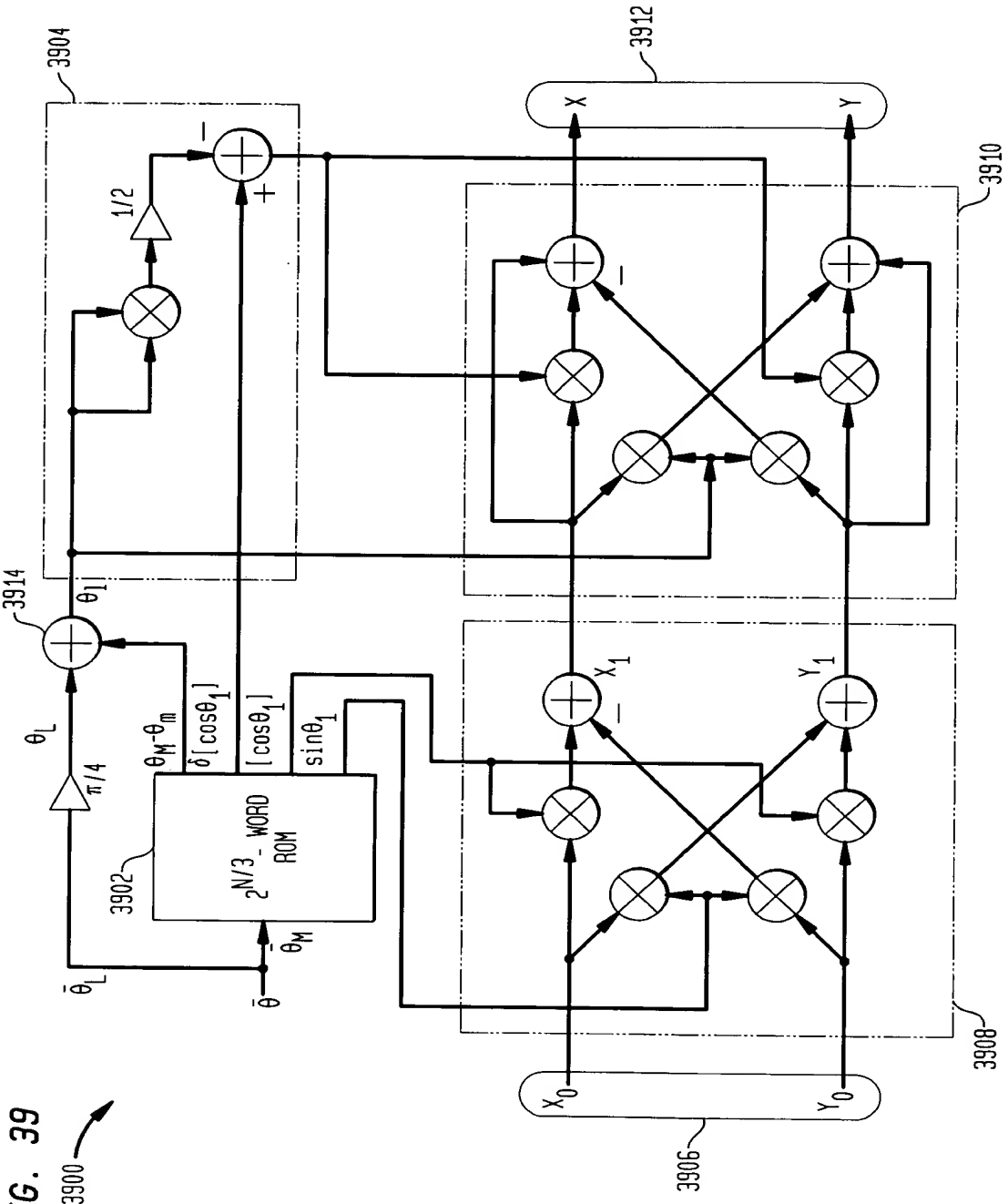
3904
3912
3910
3914
3902
3908
3906
3900
1/2
π/4
X
Y
X1
Y1
X0
Y0
θL
θ1
θM-θm
δ[cosθ1]
[cosθ1]
sinθ1
2N/3 - WORD ROM
θ̄L
θ̄M
θ̄

FIG. 39

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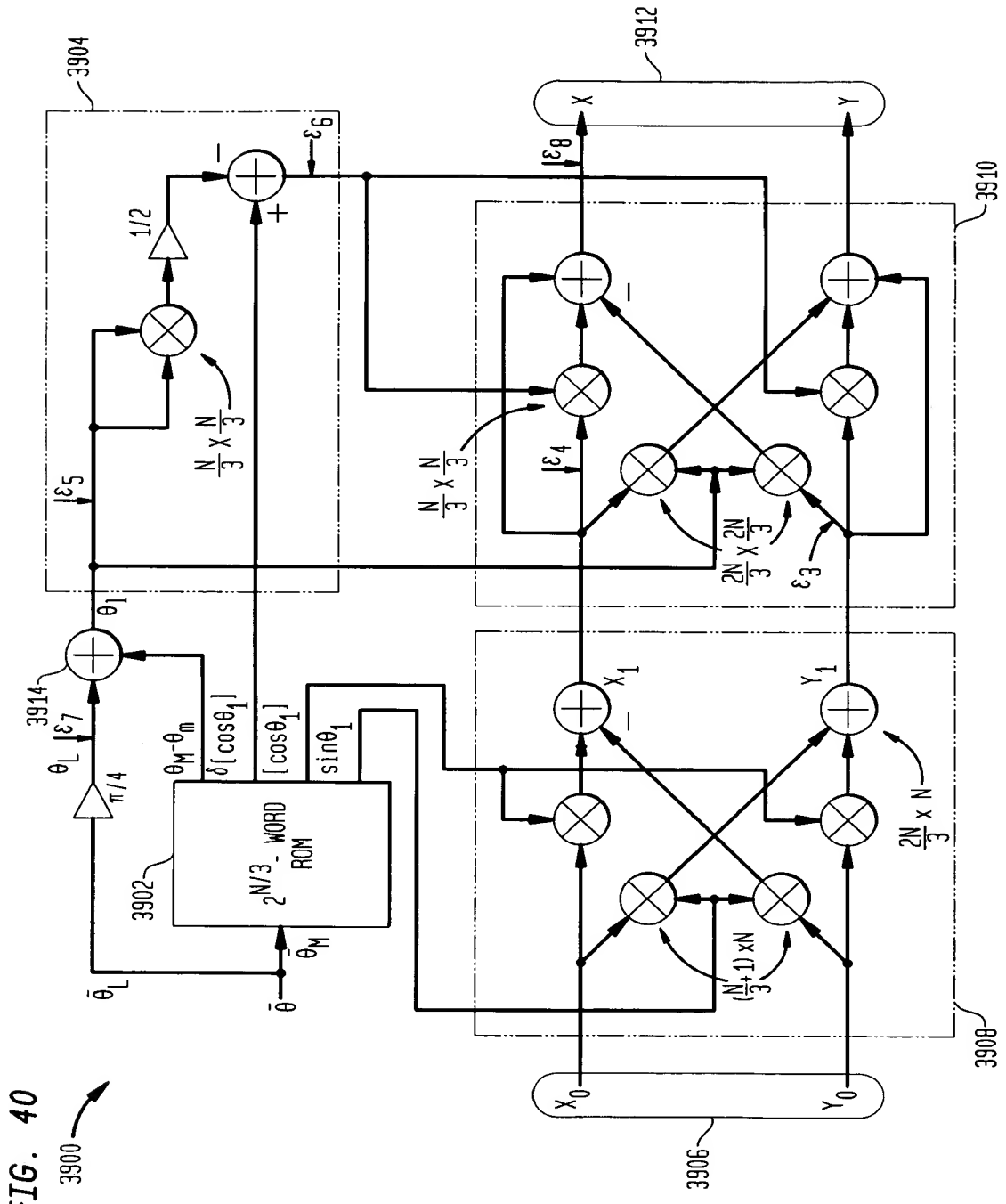
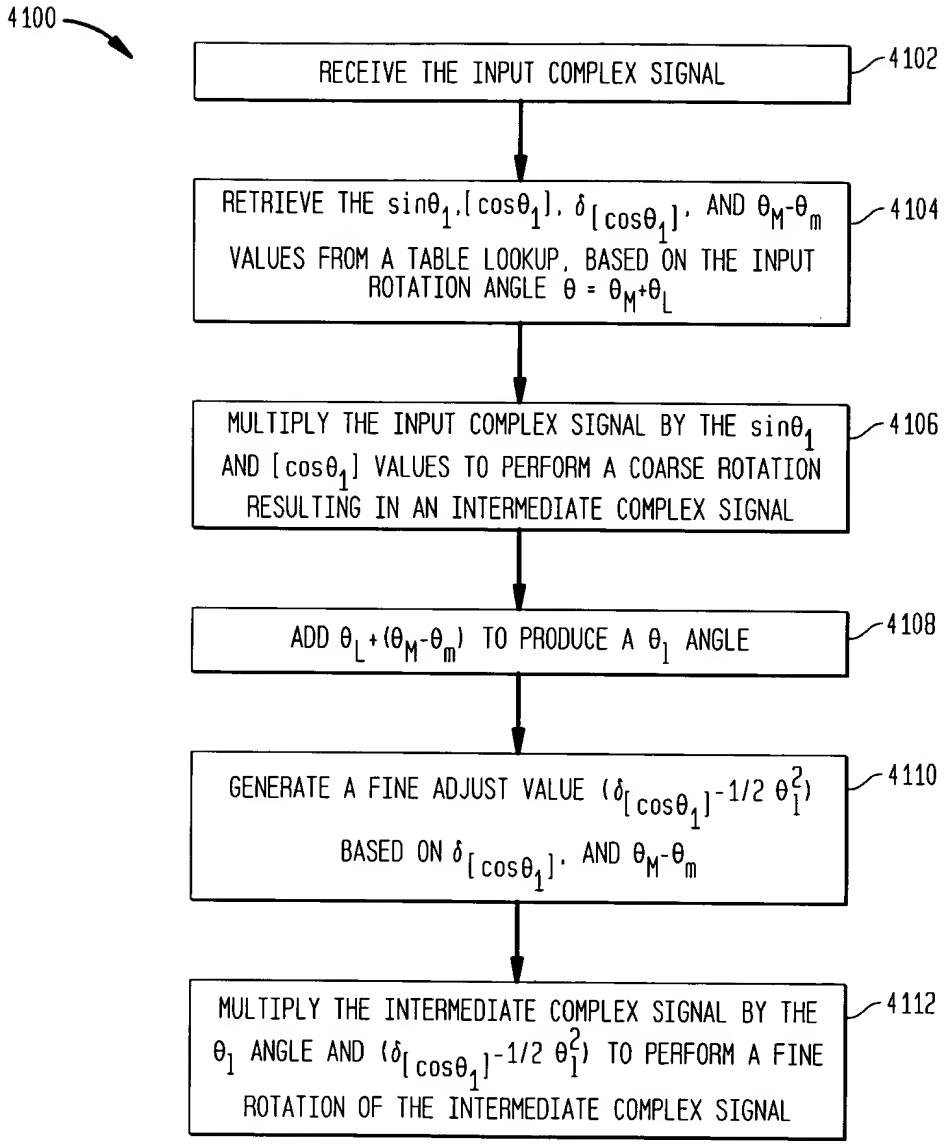

3900
3902
3904
3906
3908
3910
3912
3914
2N/3 - WORD ROM
1/2
π/4
X
Y
X0
Y0
X1
Y1
ε3
ε4
ε5
ε7
ε8
ε9
θ1
θL
θM
θ
θM-θm
δ[cosθ1]
[cosθ1]
sinθ1
N/3 x N/3
2N/3 x 2N/3
2N/3 x N
(N/3+1) x N

FIG. 40

FIG. 41


4100
RECEIVE THE INPUT COMPLEX SIGNAL
4102
RETRIEVE THE $\sin\theta_1$, $[\cos\theta_1]$, $\delta_{[\cos\theta_1]}$, AND θ_M-θ_m VALUES FROM A TABLE LOOKUP, BASED ON THE INPUT ROTATION ANGLE $\theta = \theta_M+\theta_L$
4104
MULTIPLY THE INPUT COMPLEX SIGNAL BY THE $\sin\theta_1$ AND $[\cos\theta_1]$ VALUES TO PERFORM A COARSE ROTATION RESULTING IN AN INTERMEDIATE COMPLEX SIGNAL
4106
ADD $\theta_L+(\theta_M-\theta_m)$ TO PRODUCE A θ_1 ANGLE
4108
GENERATE A FINE ADJUST VALUE $(\delta_{[\cos\theta_1]}-1/2\ \theta_1^2)$ BASED ON $\delta_{[\cos\theta_1]}$, AND θ_M-θ_m
4110
MULTIPLY THE INTERMEDIATE COMPLEX SIGNAL BY THE θ_1 ANGLE AND $(\delta_{[\cos\theta_1]}-1/2\ \theta_1^2)$ TO PERFORM A FINE ROTATION OF THE INTERMEDIATE COMPLEX SIGNAL
4112

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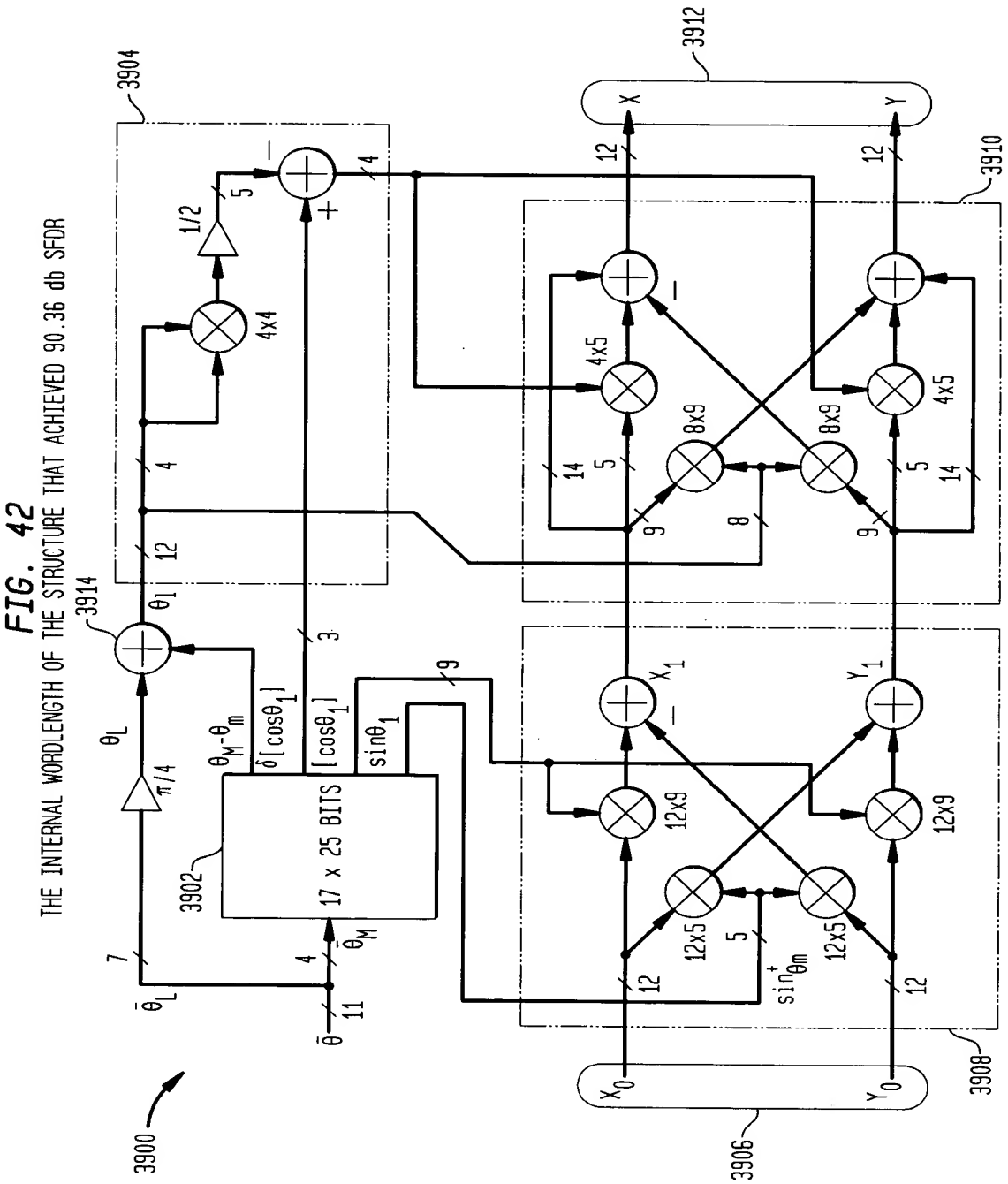
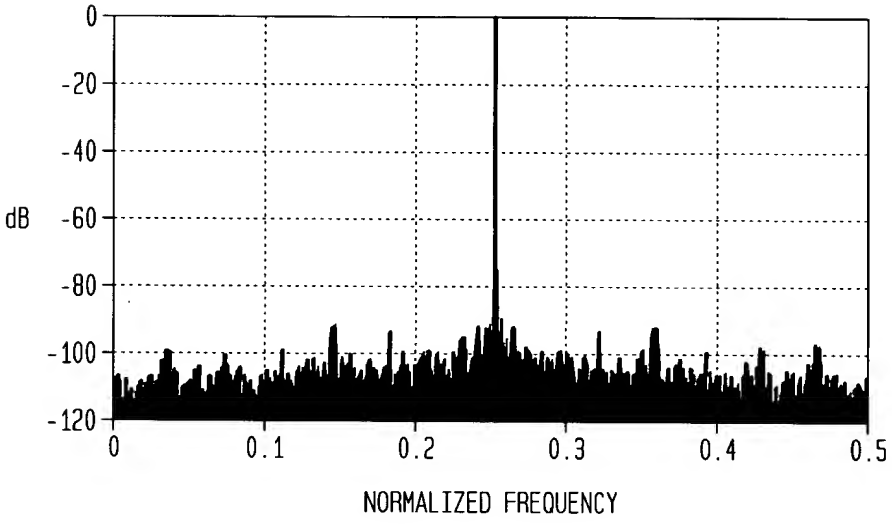


FIG. 42
THE INTERNAL WORDLENGTH OF THE STRUCTURE THAT ACHIEVED 90.36 db SFDR

FIG. 43

OUTPUT SPECTRUM SHOWING 90.36 dB SFDR



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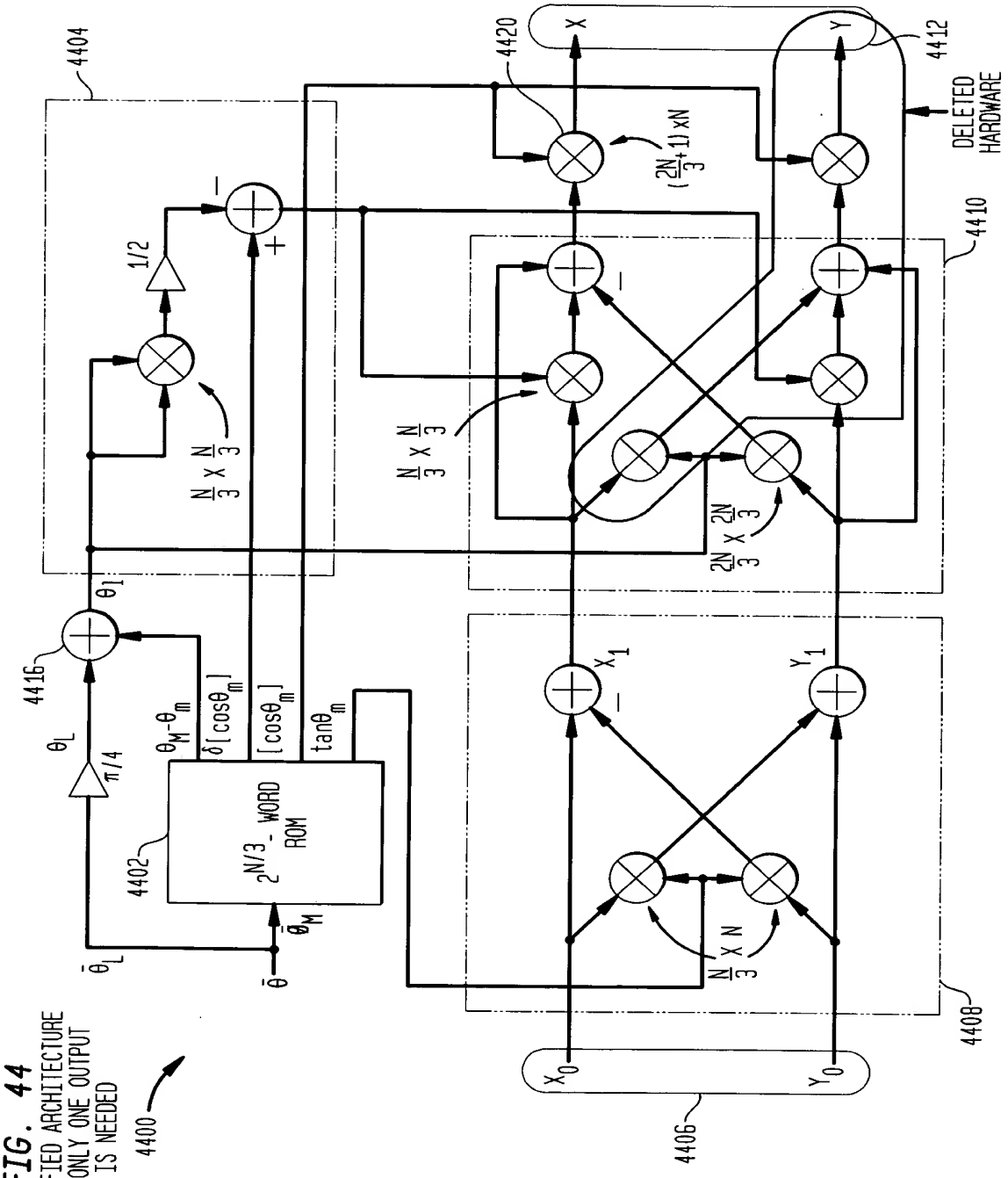

FIG. 44
A MODIFIED ARCHITECTURE WHEN ONLY ONE OUTPUT IS NEEDED

FIG. 45

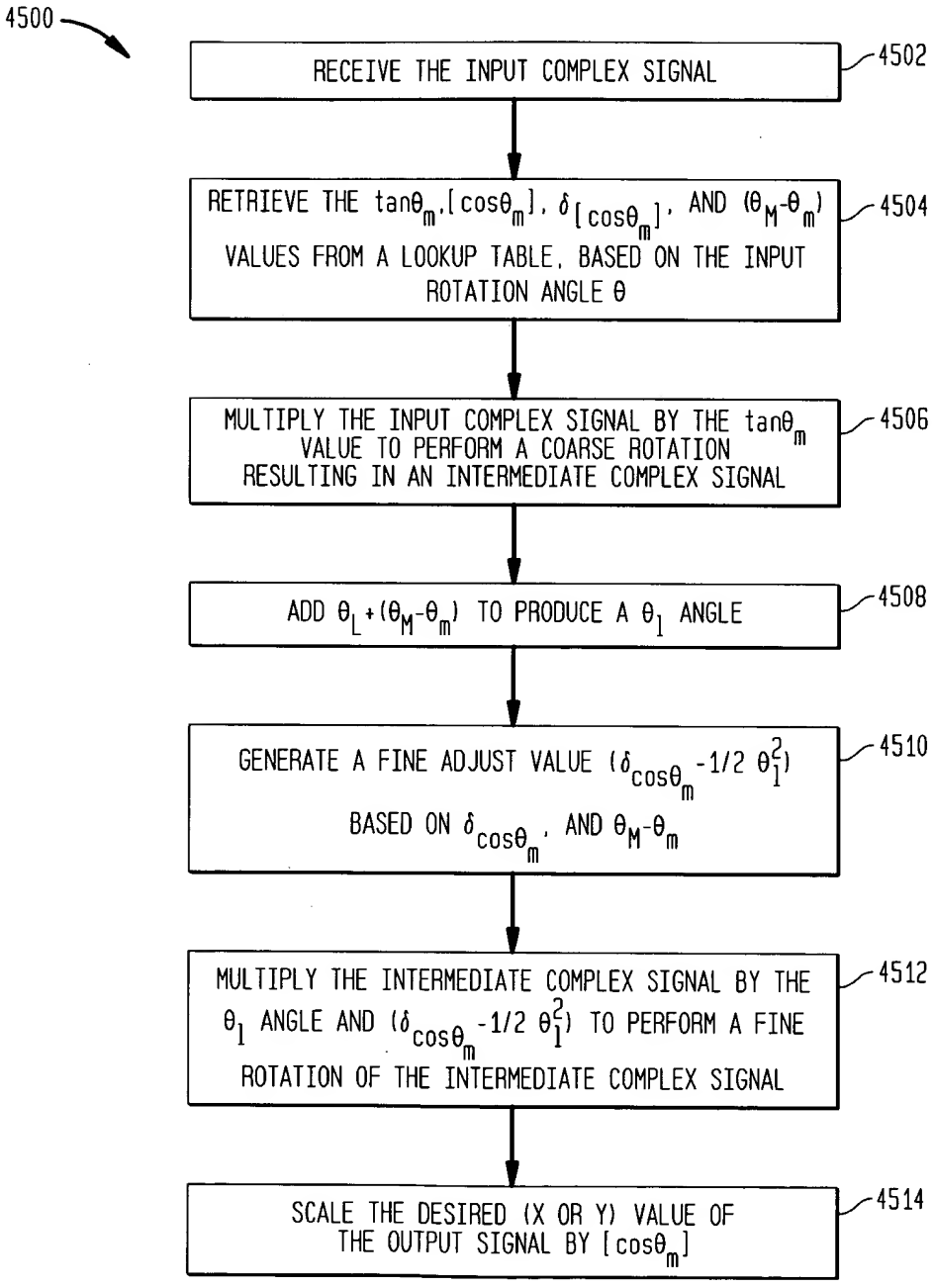
4500
RECEIVE THE INPUT COMPLEX SIGNAL
4502
RETRIEVE THE $\tan\theta_m$, $[\cos\theta_m]$, $\delta_{[\cos\theta_m]}$, AND $(\theta_M-\theta_m)$ VALUES FROM A LOOKUP TABLE, BASED ON THE INPUT ROTATION ANGLE θ
4504
MULTIPLY THE INPUT COMPLEX SIGNAL BY THE $\tan\theta_m$ VALUE TO PERFORM A COARSE ROTATION RESULTING IN AN INTERMEDIATE COMPLEX SIGNAL
4506
ADD $\theta_L+(\theta_M-\theta_m)$ TO PRODUCE A θ_1 ANGLE
4508
GENERATE A FINE ADJUST VALUE $(\delta_{\cos\theta_m}-1/2\ \theta_1^2)$ BASED ON $\delta_{\cos\theta_m}$, AND $\theta_M-\theta_m$
4510
MULTIPLY THE INTERMEDIATE COMPLEX SIGNAL BY THE θ_1 ANGLE AND $(\delta_{\cos\theta_m}-1/2\ \theta_1^2)$ TO PERFORM A FINE ROTATION OF THE INTERMEDIATE COMPLEX SIGNAL
4512
SCALE THE DESIRED (X OR Y) VALUE OF THE OUTPUT SIGNAL BY $[\cos\theta_m]$
4514

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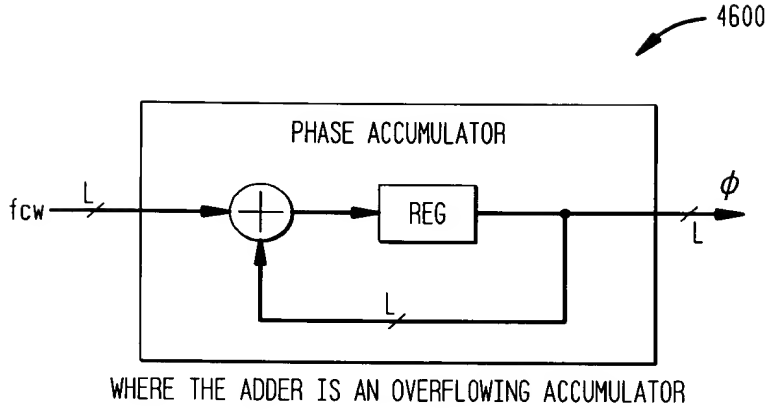
FIG. 46



WHERE THE ADDER IS AN OVERFLOWING ACCUMULATOR

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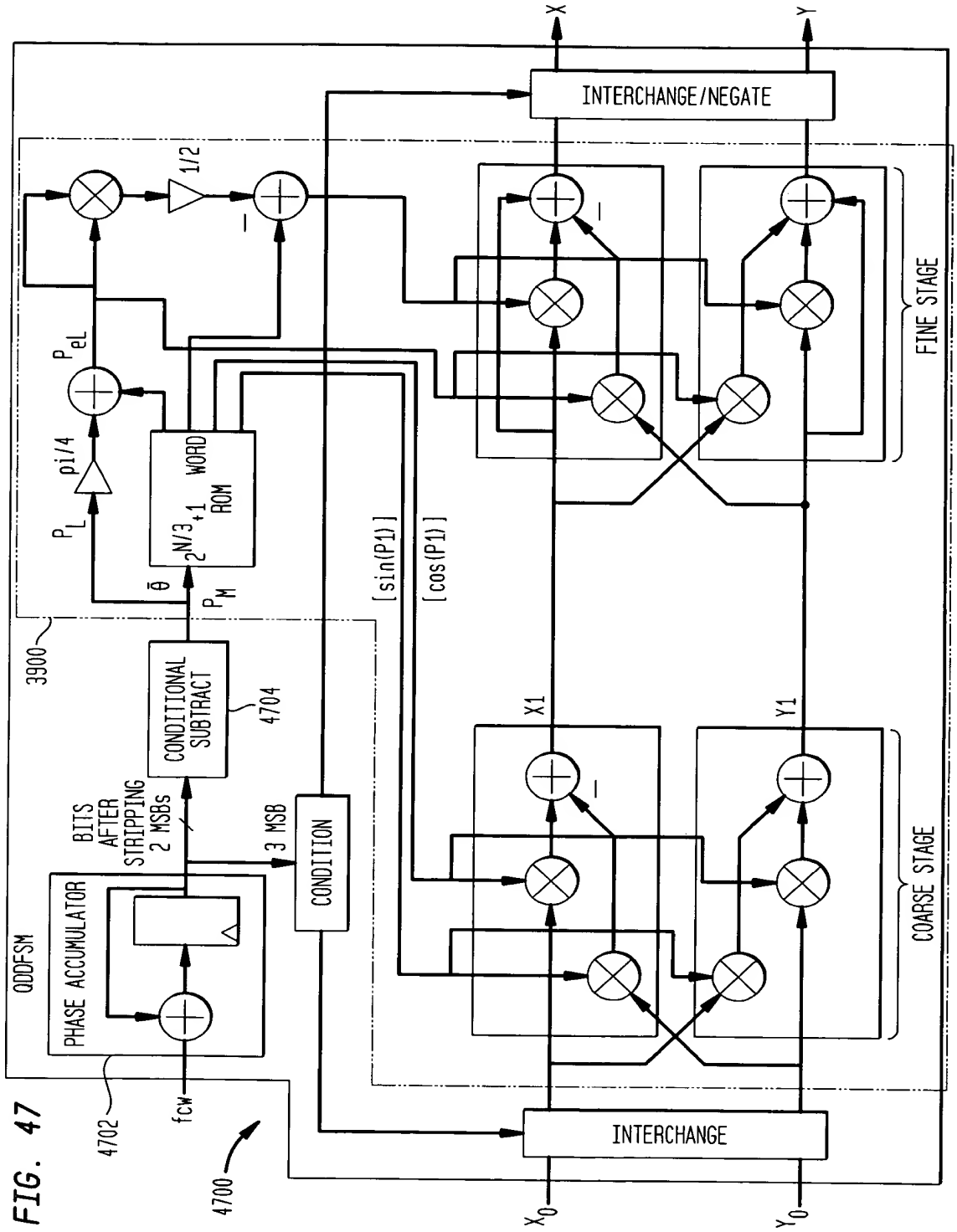
X
Y
INTERCHANGE/NEGATE
1/2
FINE STAGE
P_{eL}
pi/4
P_L
$2^{N/3+1}$ WORD ROM
θ
P_M
[sin(P1)]
[cos(P1)]
3900
CONDITIONAL SUBTRACT
4704
X1
Y1
BITS AFTER STRIPPING 2 MSBs
3 MSB
CONDITION
COARSE STAGE
ODDFSM
PHASE ACCUMULATOR
4702
fcw
4700
INTERCHANGE
X_0
Y_0

FIG. 47

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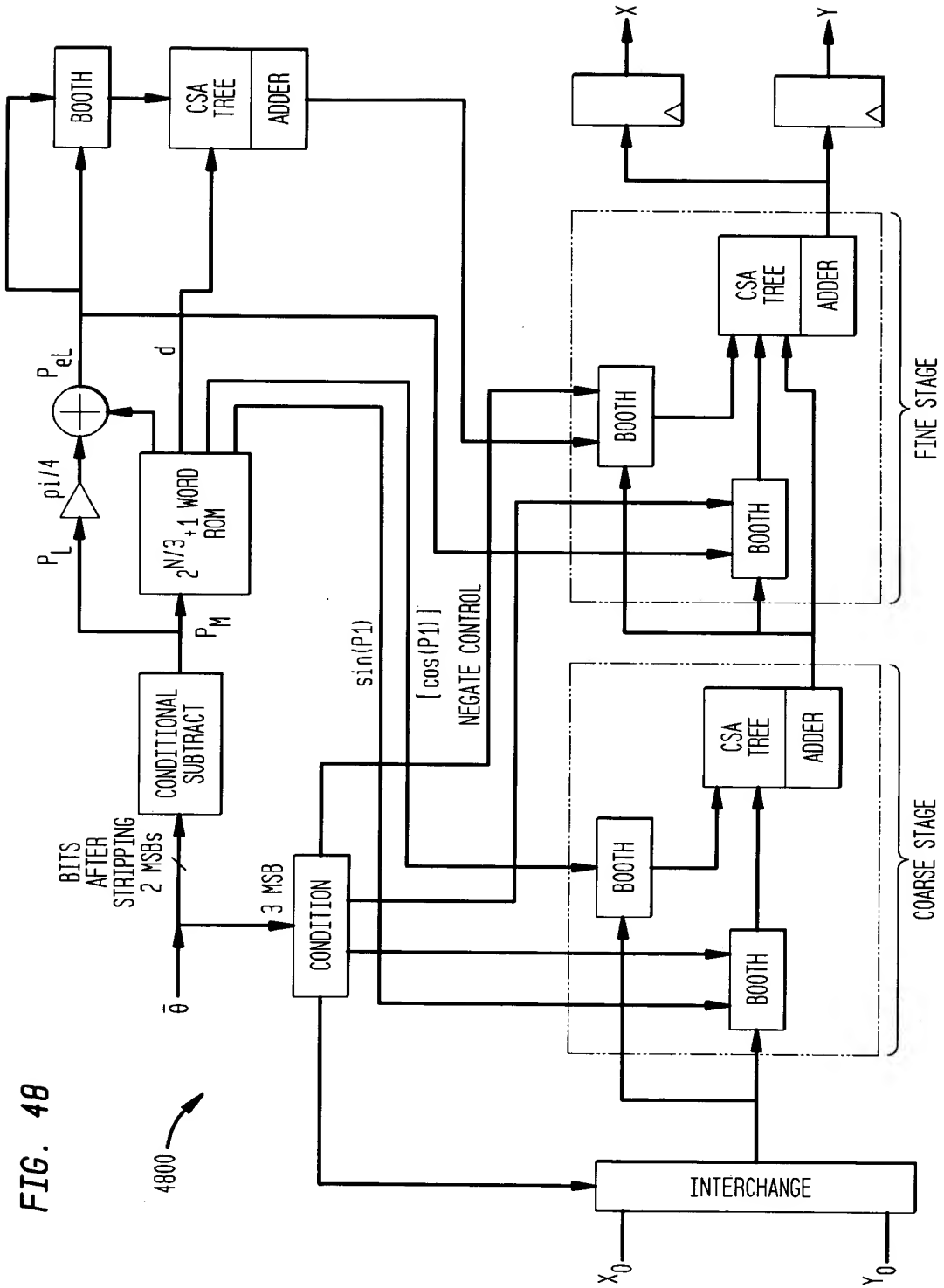
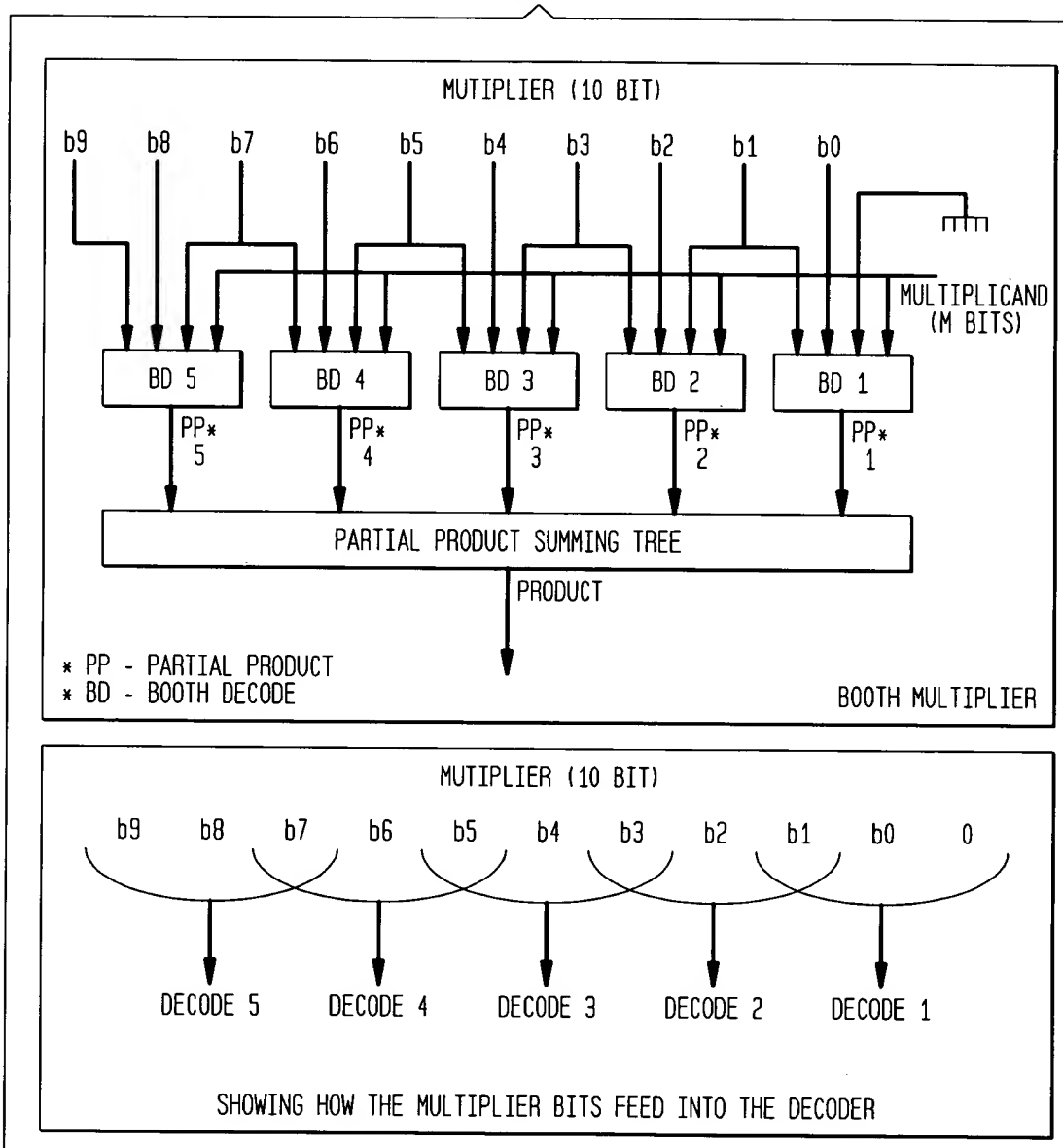

BOOTH
CSA TREE
ADDER
X
Y
P_{eL}
d
pi/4
P_L
$2^{N/3}+1$ WORD ROM
P_M
CONDITIONAL SUBTRACT
BITS AFTER STRIPPING 2 MSBs
$\bar{\theta}$
3 MSB
CONDITION
sin(P1)
[cos(P1)]
NEGATE CONTROL
FINE STAGE
COARSE STAGE
INTERCHANGE
X_0
Y_0
4800

FIG. 48

FIG. 49


MUTIPLIER (10 BIT)
b9
b8
b7
b6
b5
b4
b3
b2
b1
b0
MULTIPLICAND
(M BITS)
BD 5
BD 4
BD 3
BD 2
BD 1
PP*
5
PP*
4
PP*
3
PP*
2
PP*
1
PARTIAL PRODUCT SUMMING TREE
PRODUCT
* PP - PARTIAL PRODUCT
* BD - BOOTH DECODE
BOOTH MULTIPLIER
MUTIPLIER (10 BIT)
b9
b8
b7
b6
b5
b4
b3
b2
b1
b0
0
DECODE 5
DECODE 4
DECODE 3
DECODE 2
DECODE 1
SHOWING HOW THE MULTIPLIER BITS FEED INTO THE DECODER

5000

FIG. 50

ORIGINAL BOOTH TABLE 5002

b2	b1	b0	PP
0	0	0	0*A
0	0	1	1*A
0	1	0	1*A
0	1	1	2*A
1	0	0	-2*A
1	0	1	-1*A
1	1	0	-1*A
1	1	1	0*A

5100

FIG. 51

NEGATING BOOTH TABLE 5102

b2	b1	b0	PP
0	0	0	0*A
0	0	1	-1*A
0	1	0	-1*A
0	1	1	-2*A
1	0	0	2*A
1	0	1	1*A
1	1	0	1*A
1	1	1	0*A

FIG. 52

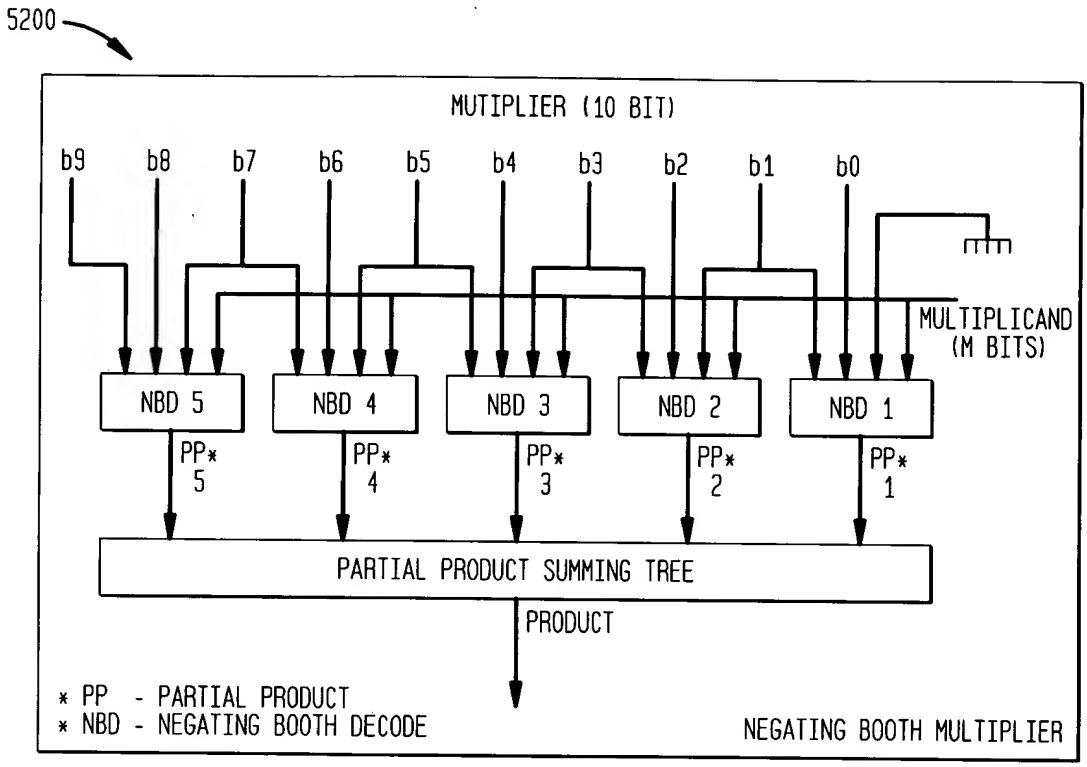

5200
MUTIPLIER (10 BIT)
b9
b8
b7
b6
b5
b4
b3
b2
b1
b0
MULTIPLICAND
(M BITS)
NBD 5
NBD 4
NBD 3
NBD 2
NBD 1
PP*
5
PP*
4
PP*
3
PP*
2
PP*
1
PARTIAL PRODUCT SUMMING TREE
PRODUCT
* PP - PARTIAL PRODUCT
* NBD - NEGATING BOOTH DECODE
NEGATING BOOTH MULTIPLIER

FIG. 53

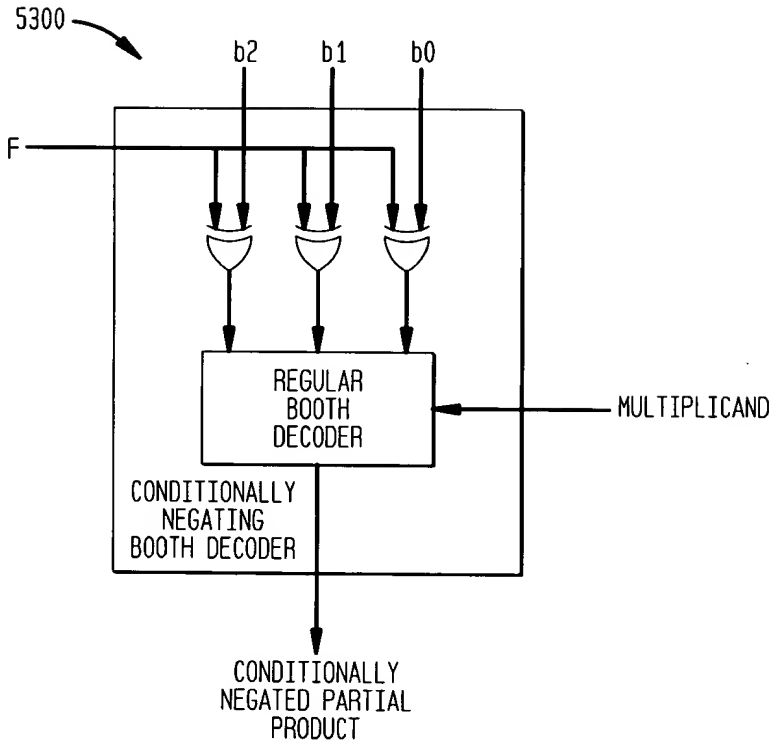
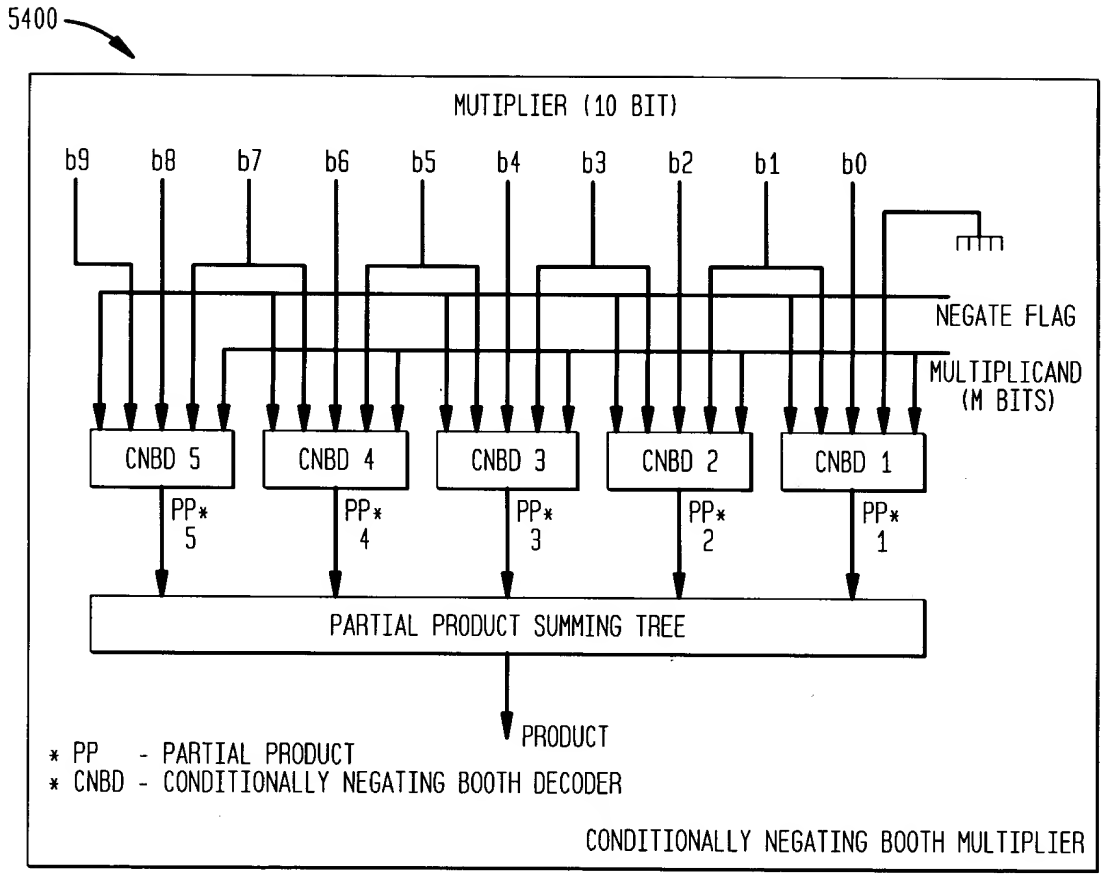

5300
b2
b1
b0
F
REGULAR
BOOTH
DECODER
MULTIPLICAND
CONDITIONALLY
NEGATING
BOOTH DECODER
CONDITIONALLY
NEGATED PARTIAL
PRODUCT

FIG. 54


5400
MUTIPLIER (10 BIT)
b9
b8
b7
b6
b5
b4
b3
b2
b1
b0
NEGATE FLAG
MULTIPLICAND
(M BITS)
CNBD 5
CNBD 4
CNBD 3
CNBD 2
CNBD 1
PP*
5
PP*
4
PP*
3
PP*
2
PP*
1
PARTIAL PRODUCT SUMMING TREE
PRODUCT
* PP - PARTIAL PRODUCT
* CNBD - CONDITIONALLY NEGATING BOOTH DECODER
CONDITIONALLY NEGATING BOOTH MULTIPLIER

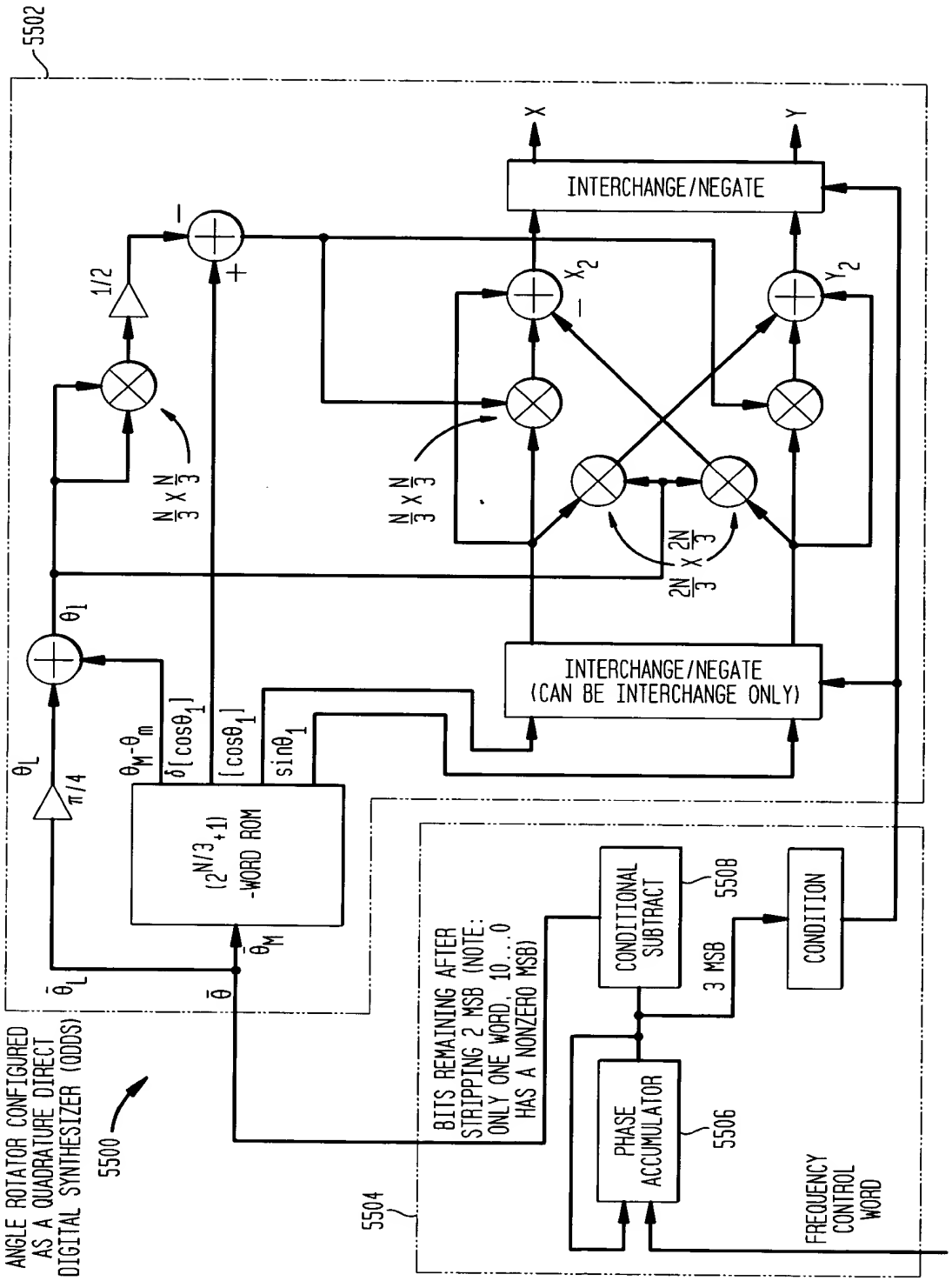


FIG. 55
ANGLE ROTATOR CONFIGURED AS A QUADRATURE DIRECT DIGITAL SYNTHESIZER (QDDS)

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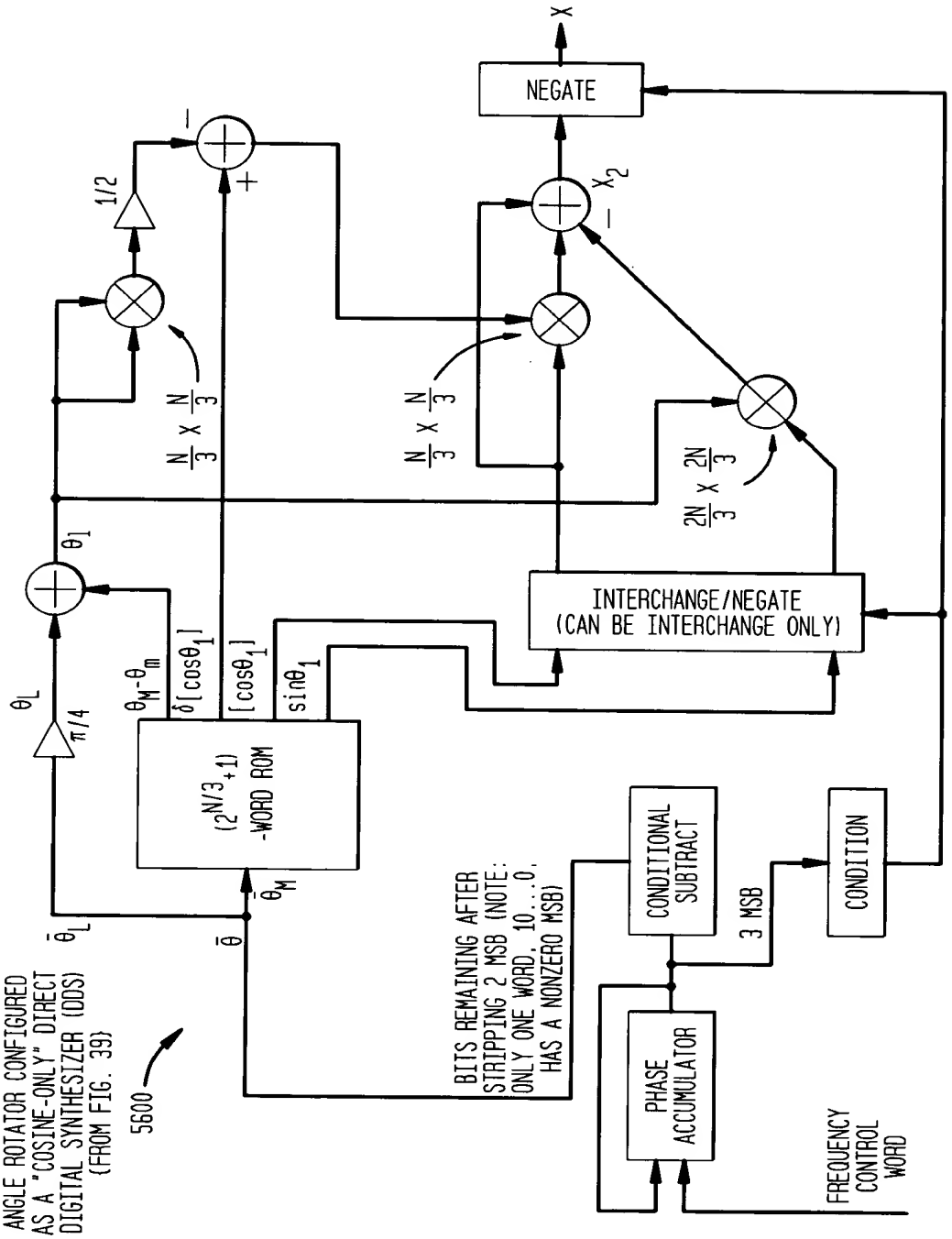


FIG. 56
ANGLE ROTATOR CONFIGURED AS A "COSINE-ONLY" DIRECT DIGITAL SYNTHESIZER (DDS) (FROM FIG. 39)

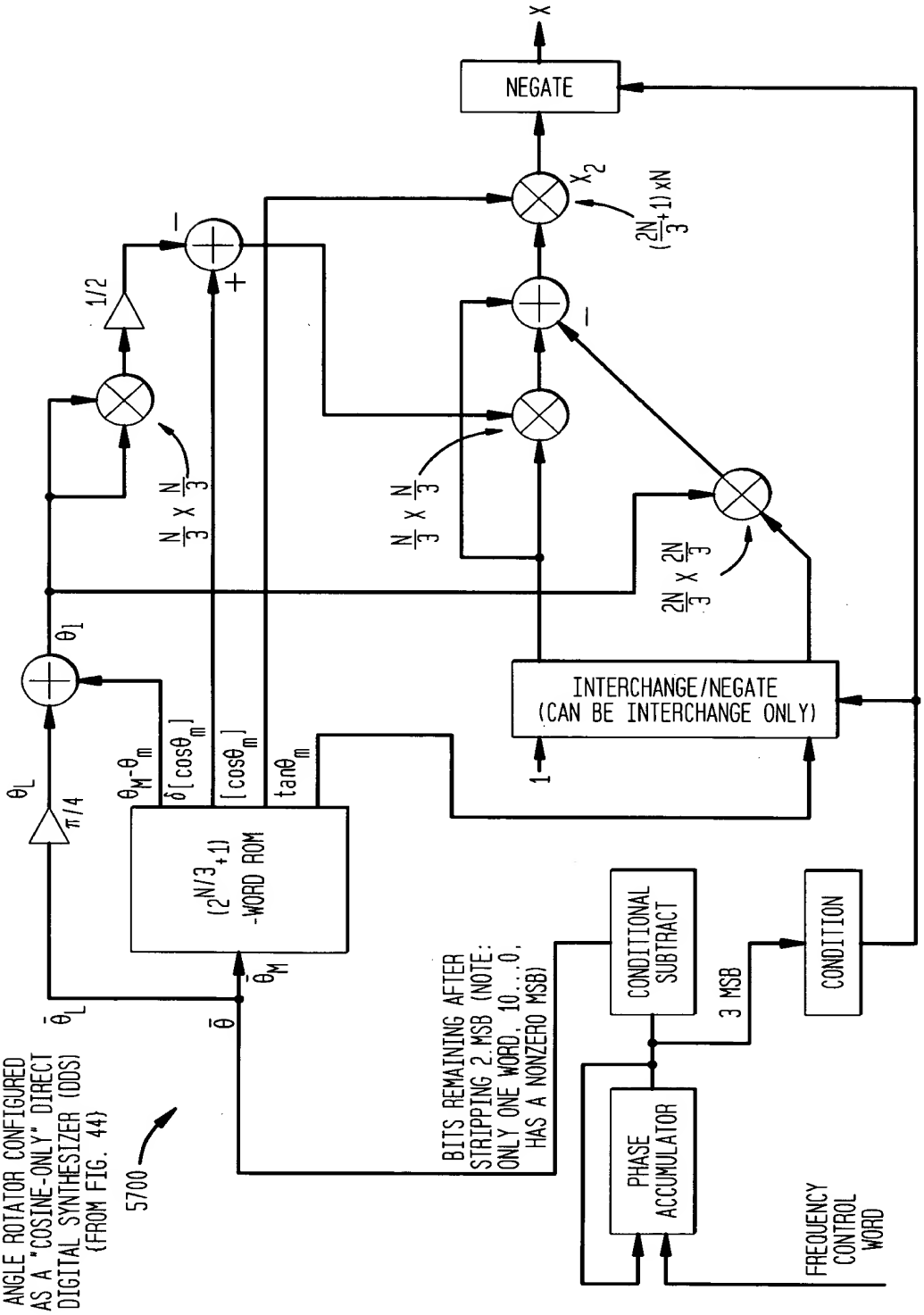


FIG. 57
ANGLE ROTATOR CONFIGURED AS A "COSINE-ONLY" DIRECT DIGITAL SYNTHESIZER (DDS) (FROM FIG. 44)

FIG. 58
COMMON PACKET FORMAT

FIG. 59
THE SIMPLIFIED SYSTEM MODEL

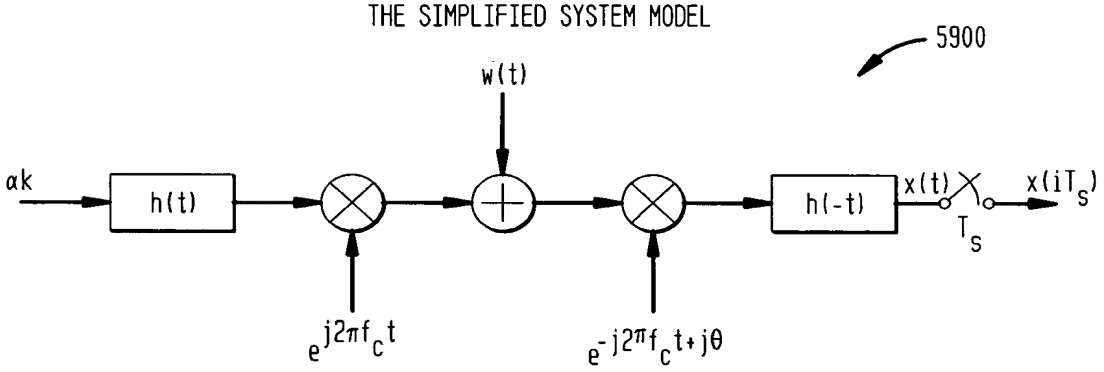
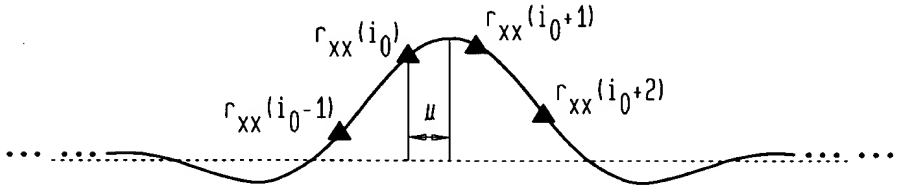


FIG. 60
MEAN VALUES OF THE PREAMBLE CORRELATOR OUTPUT, FOR θ=0



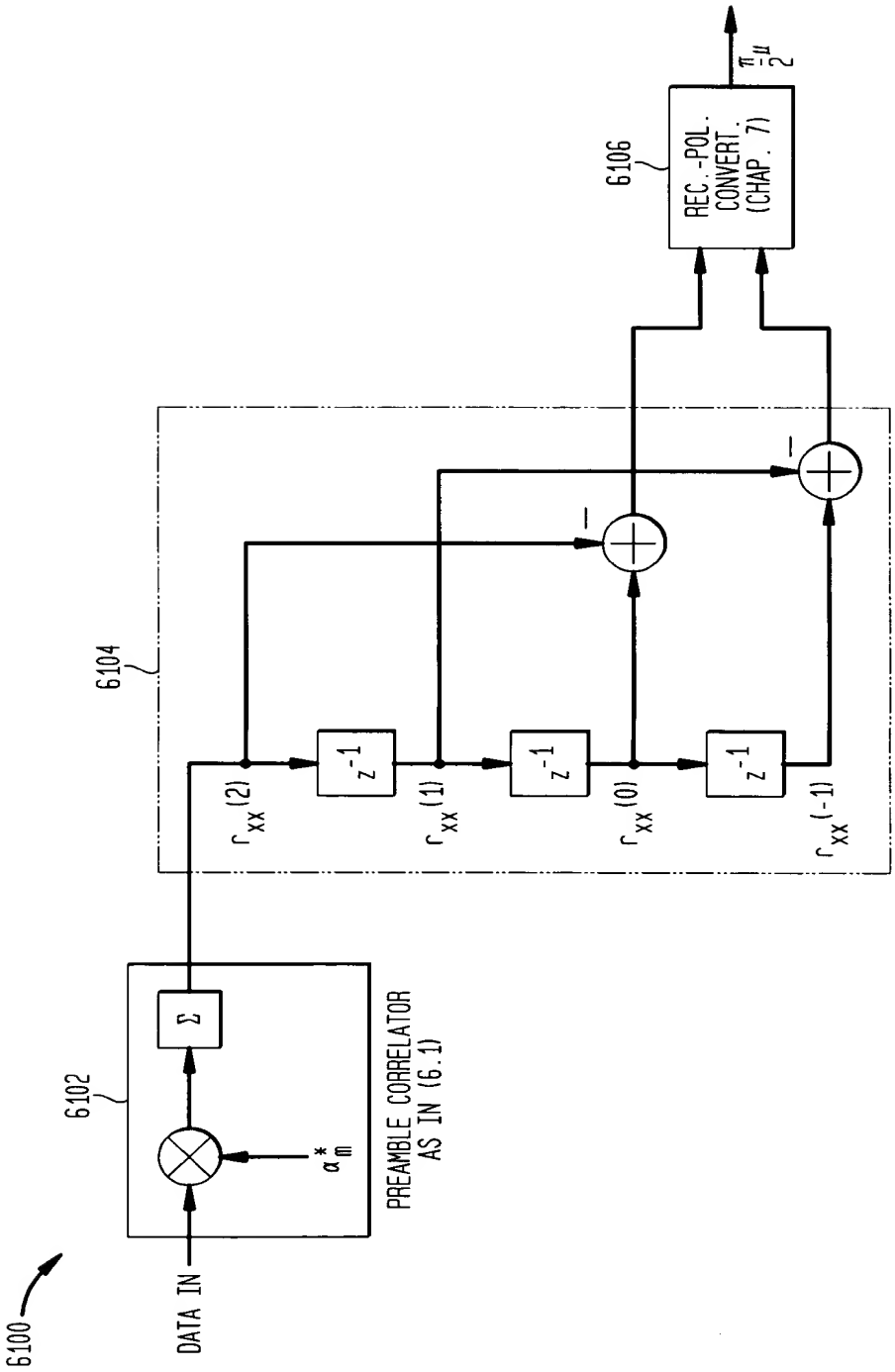


FIG. 61
PRELIMINARY SYMBOL-TIMING ESTIMATION STRUCTURE

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FIG. 62

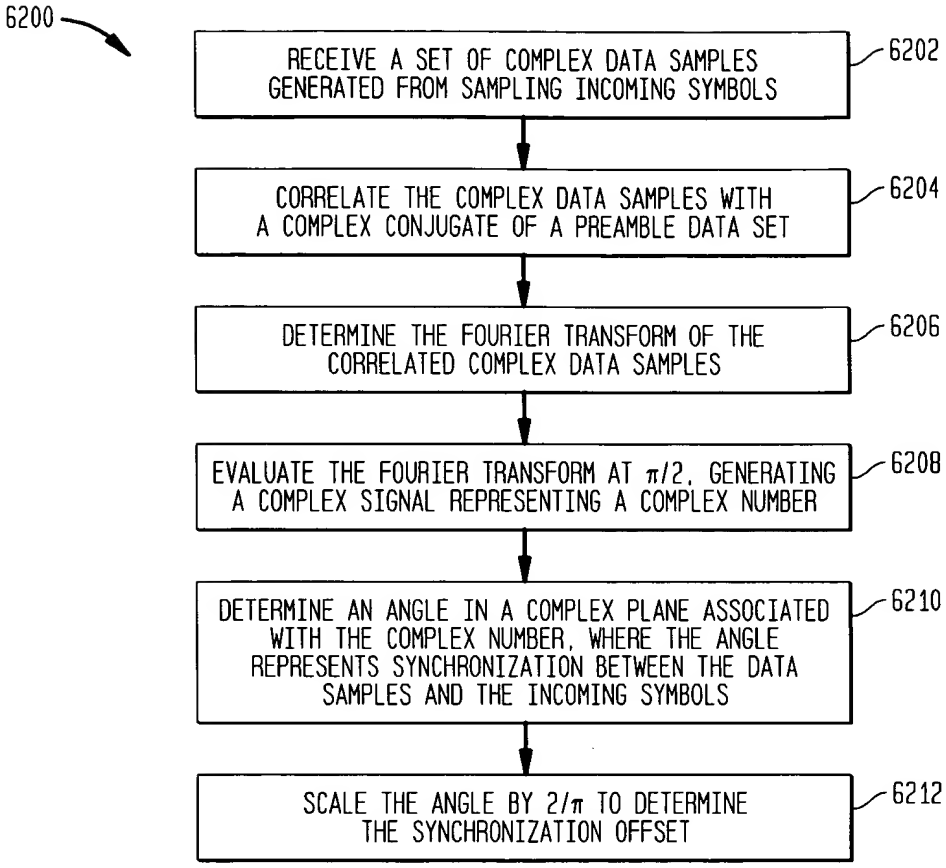
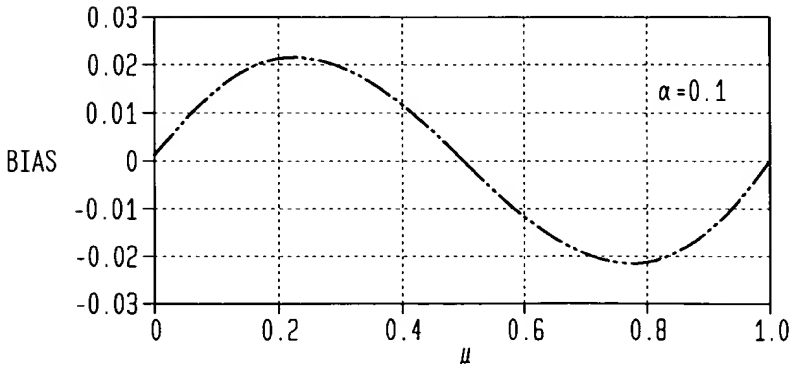


FIG. 63

BIAS DUE TO TRUNCATION



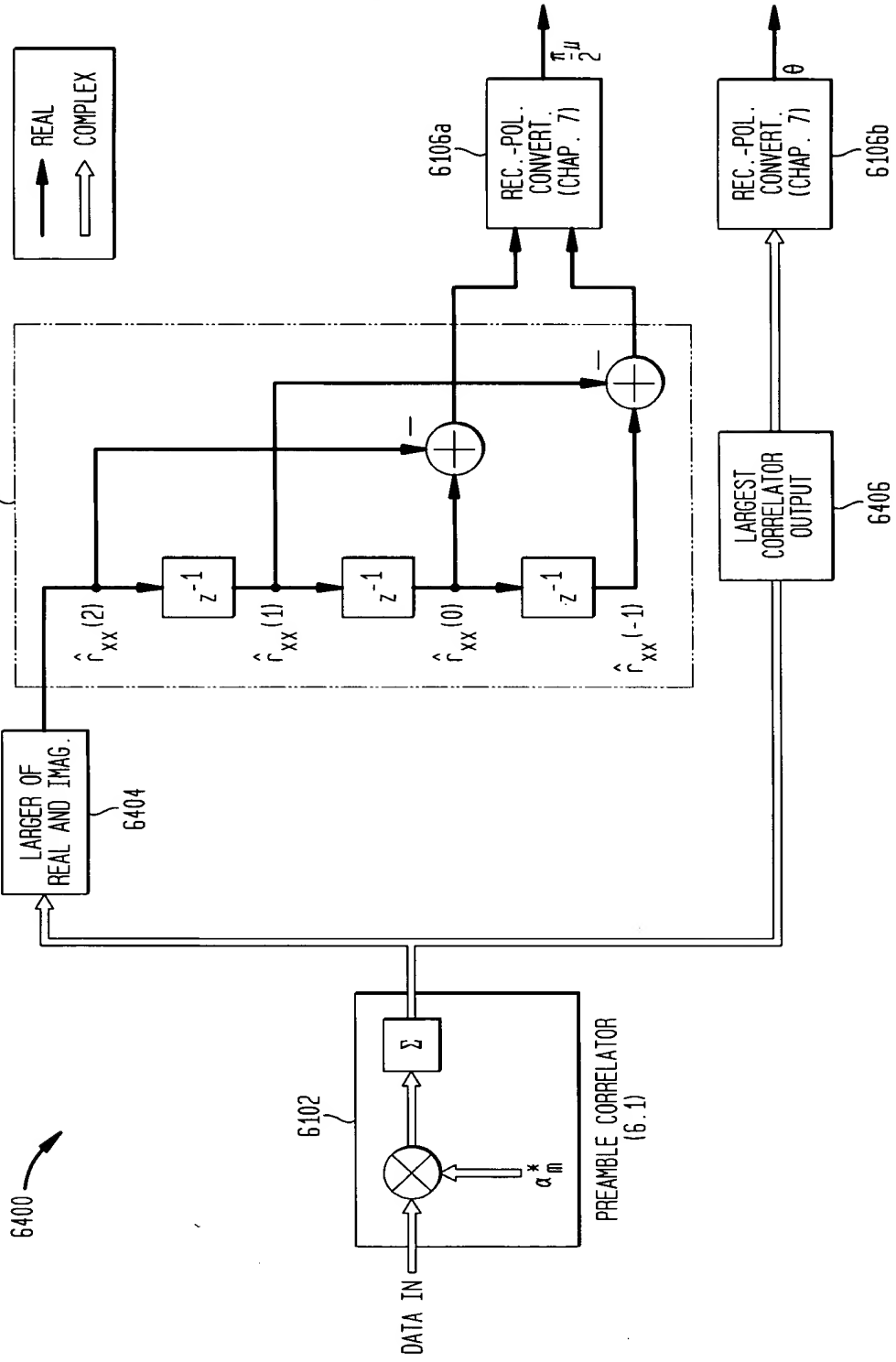
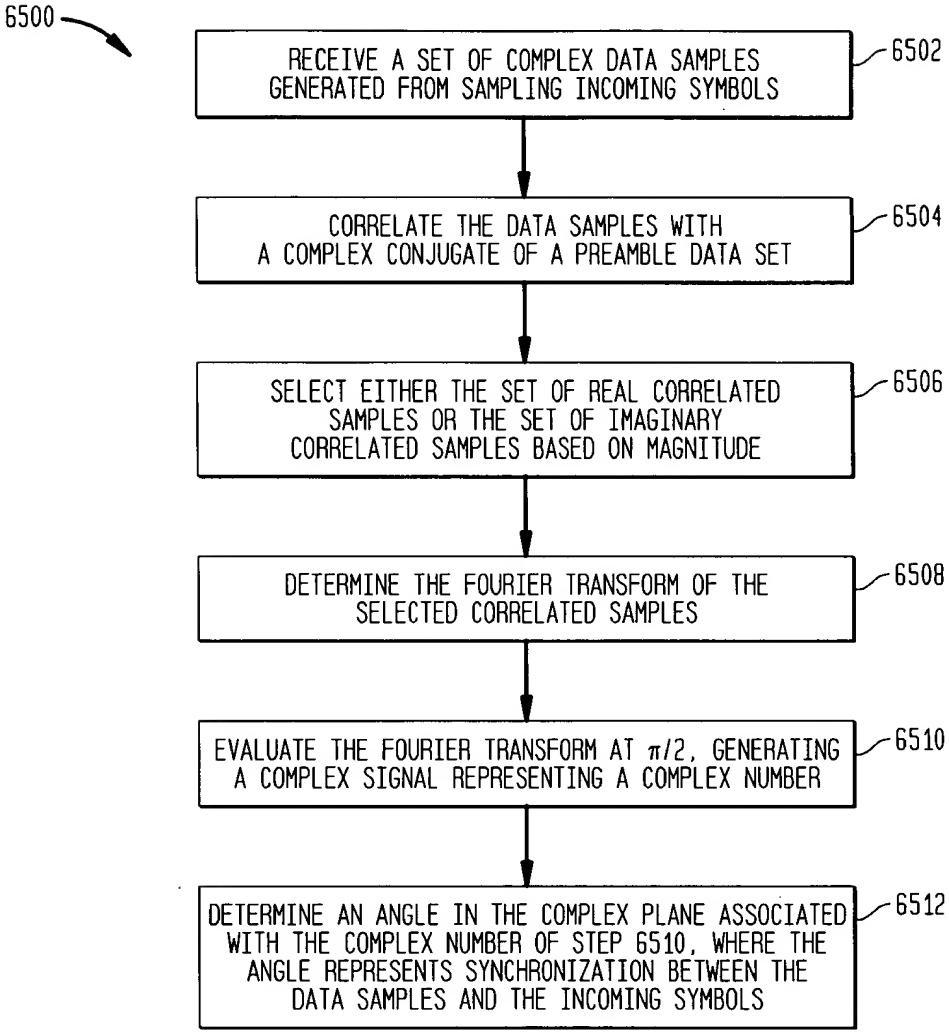


FIG. 64
STRUCTURE FOR CARRIER-PHASE AND SYMBOL TIMING RECOVERY

FIG. 65A


6500
RECEIVE A SET OF COMPLEX DATA SAMPLES GENERATED FROM SAMPLING INCOMING SYMBOLS
6502
CORRELATE THE DATA SAMPLES WITH A COMPLEX CONJUGATE OF A PREAMBLE DATA SET
6504
SELECT EITHER THE SET OF REAL CORRELATED SAMPLES OR THE SET OF IMAGINARY CORRELATED SAMPLES BASED ON MAGNITUDE
6506
DETERMINE THE FOURIER TRANSFORM OF THE SELECTED CORRELATED SAMPLES
6508
EVALUATE THE FOURIER TRANSFORM AT π/2, GENERATING A COMPLEX SIGNAL REPRESENTING A COMPLEX NUMBER
6510
DETERMINE AN ANGLE IN THE COMPLEX PLANE ASSOCIATED WITH THE COMPLEX NUMBER OF STEP 6510, WHERE THE ANGLE REPRESENTS SYNCHRONIZATION BETWEEN THE DATA SAMPLES AND THE INCOMING SYMBOLS
6512

6500 (CONT.)

FIG. 65B

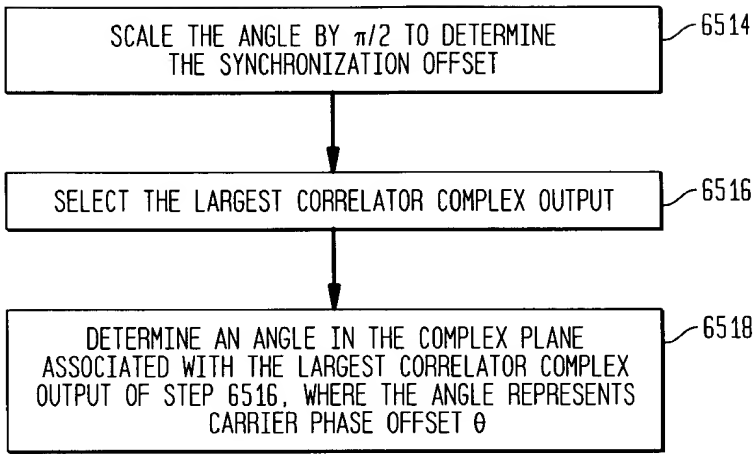


FIG. 66

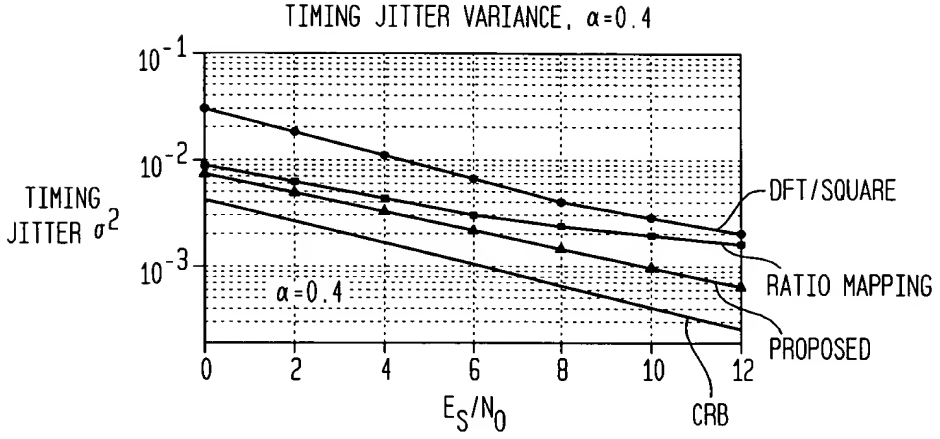


FIG. 67

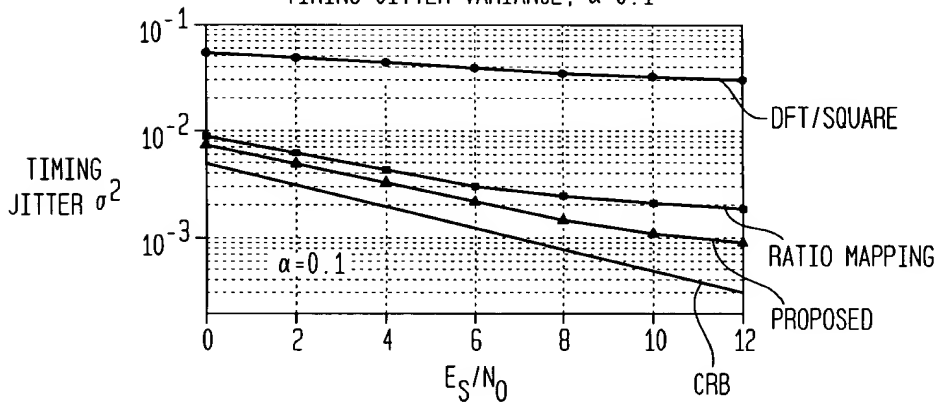


FIG. 68

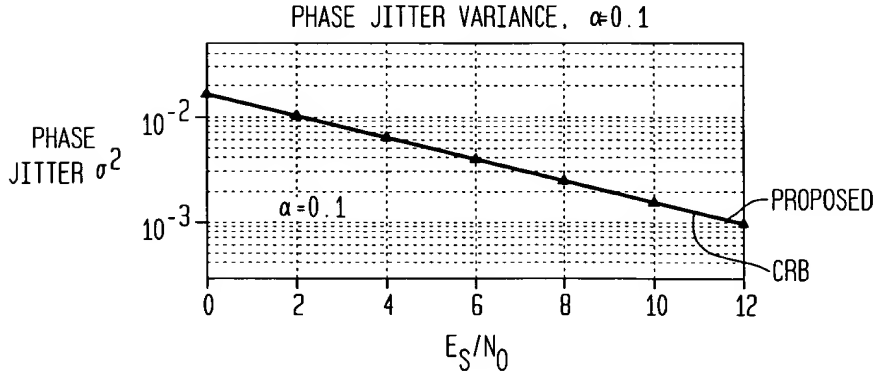


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FIG. 69
CARTESIAN TO POLAR CONVERSION

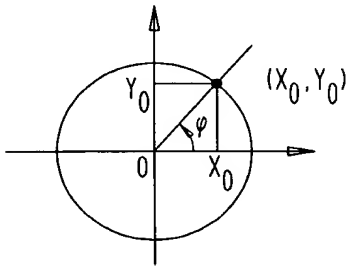

FIG. 70A
USING NEWTON-RAPHSON ITERATION TO FIND $1/X_1$

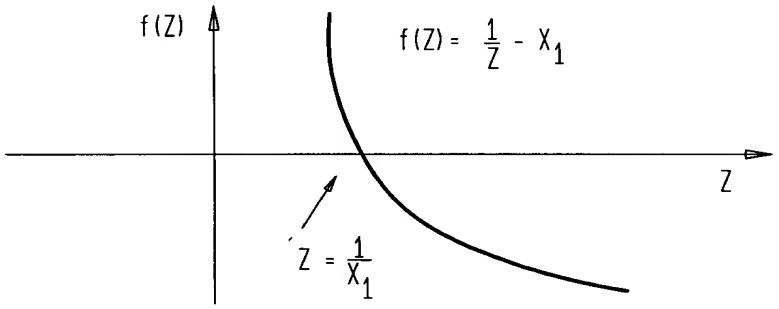

FIG. 70B
ONE NEWTON-RAPHSON ITERATION

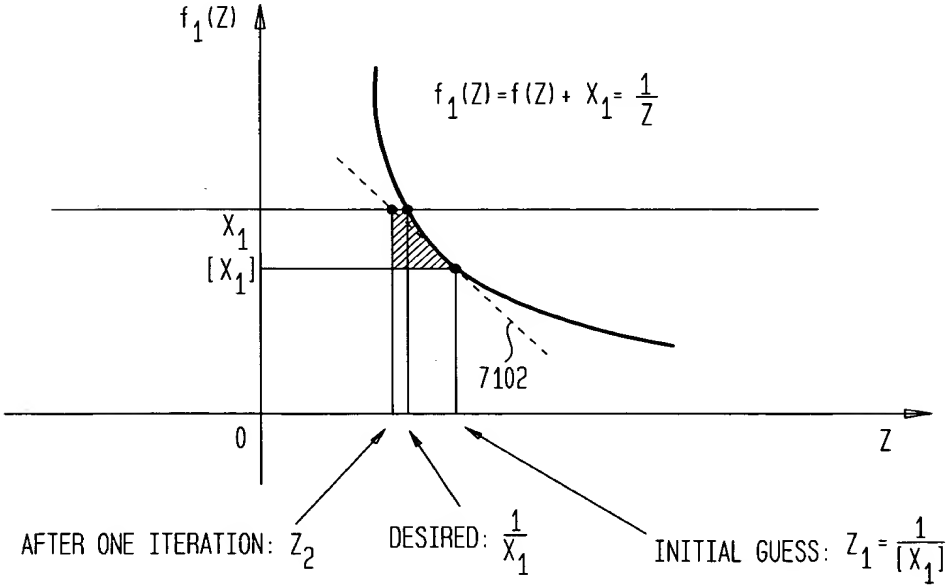

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FIG. 71

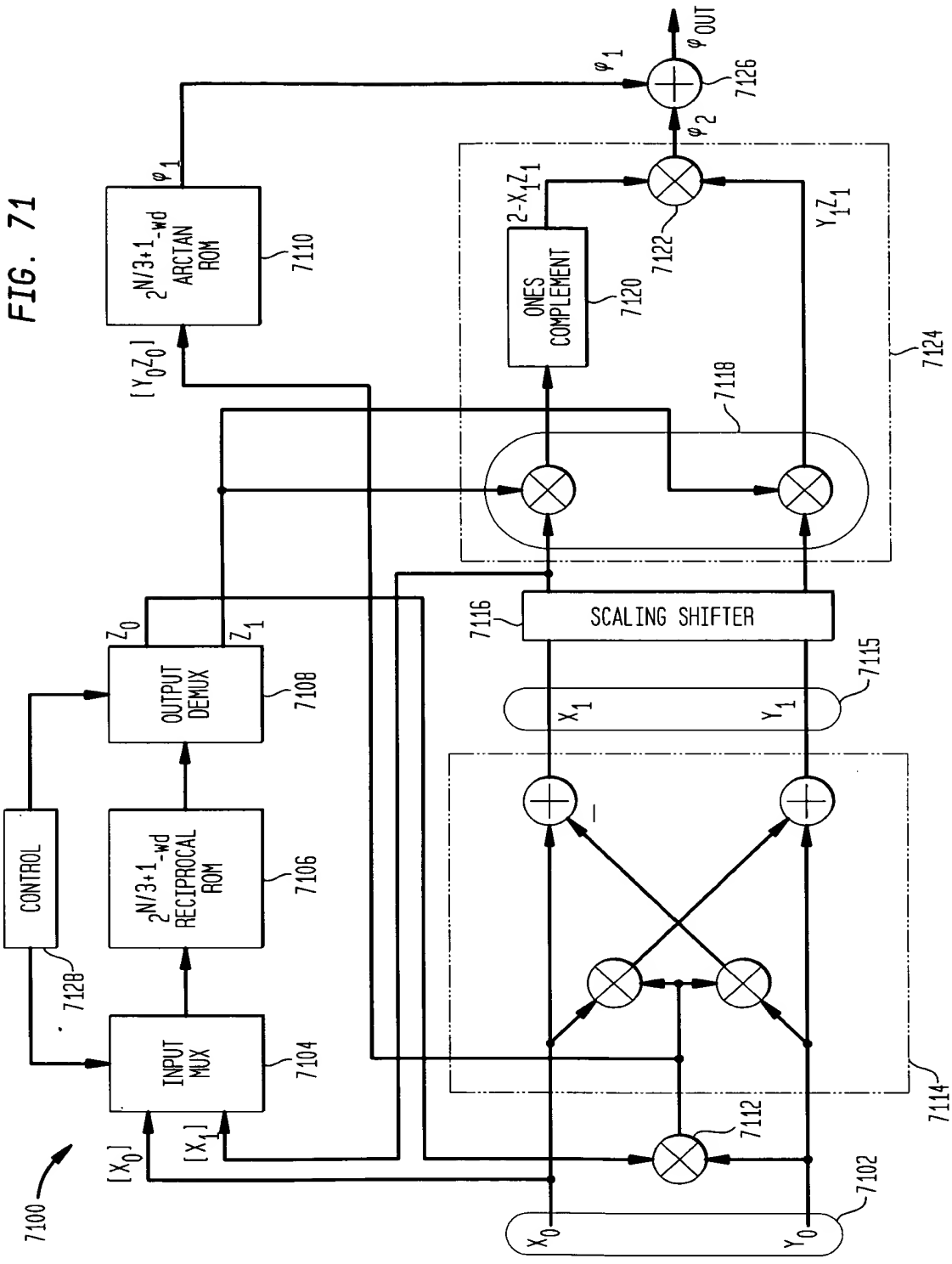
7100
CONTROL
7128
INPUT MUX
7104
$2^{N/3+1}$-wd RECIPROCAL ROM
7106
OUTPUT DEMUX
7108
$2^{N/3+1}$-wd ARCTAN ROM
7110
$[X_0]$
$[X_1]$
$[Y_0 Z_0]$
Z_0
Z_1
φ_1
φ_2
φ_{OUT}
7126
ONES COMPLEMENT
7120
$2-X_1 Z_1$
$Y_1 Z_1$
7122
7124
7118
SCALING SHIFTER
7116
7115
X_1
Y_1
7114
7112
7102
X_0
Y_0

FIG. 72

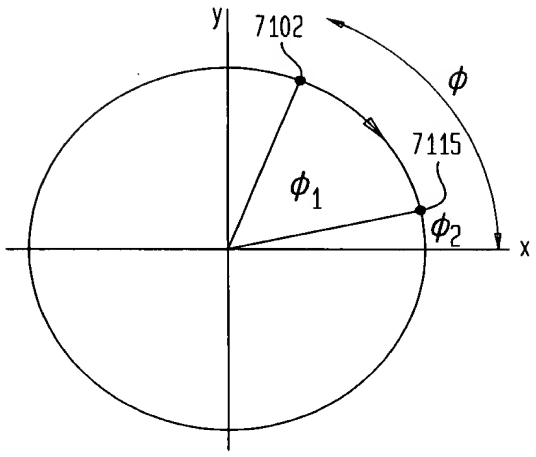

FIG. 74
INTERPOLATION IN A NON-CENTER INTERVAL

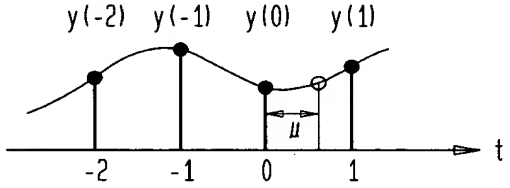

FIG. 73

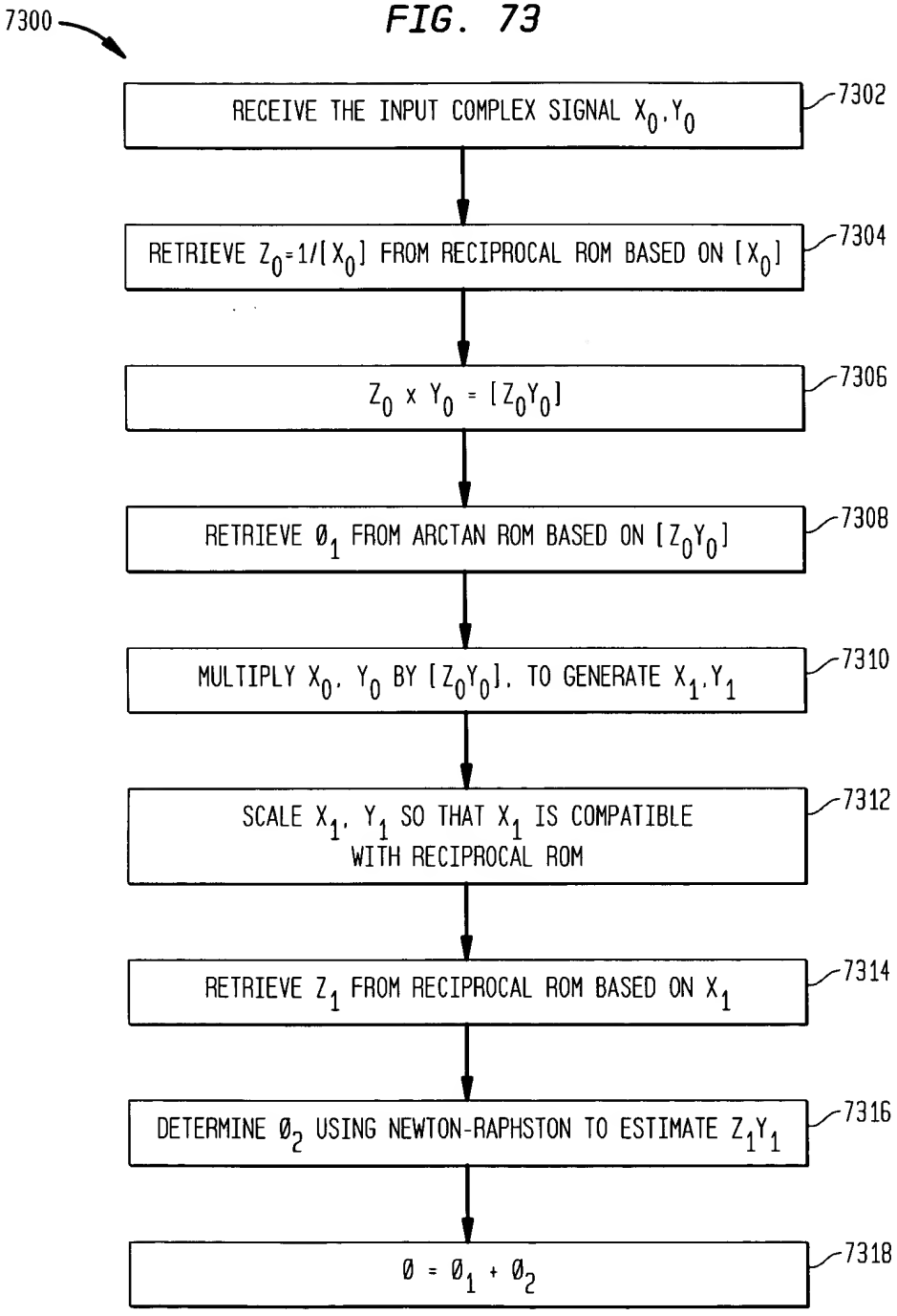
7300
RECEIVE THE INPUT COMPLEX SIGNAL X_0, Y_0
7302
RETRIEVE $Z_0 = 1/[X_0]$ FROM RECIPROCAL ROM BASED ON $[X_0]$
7304
$Z_0 \times Y_0 = [Z_0 Y_0]$
7306
RETRIEVE $\emptyset_1$ FROM ARCTAN ROM BASED ON $[Z_0 Y_0]$
7308
MULTIPLY X_0, Y_0 BY $[Z_0 Y_0]$, TO GENERATE X_1, Y_1
7310
SCALE X_1, Y_1 SO THAT X_1 IS COMPATIBLE WITH RECIPROCAL ROM
7312
RETRIEVE Z_1 FROM RECIPROCAL ROM BASED ON X_1
7314
DETERMINE $\emptyset_2$ USING NEWTON-RAPHSTON TO ESTIMATE $Z_1 Y_1$
7316
$\emptyset = \emptyset_1 + \emptyset_2$
7318

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FIG. 75A

IMPULSE RESPONSES OF THE NON-CENTER-INTERVAL INTERPOLATION FILTER BEFORE OPTIMIZATION

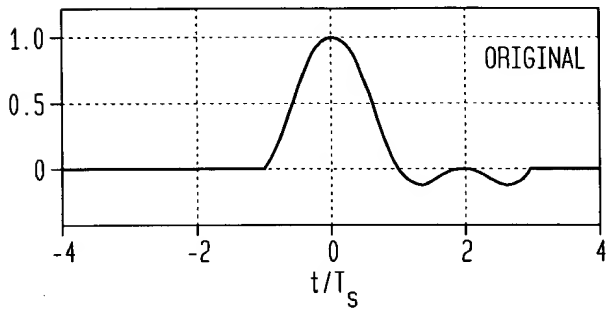

FIG. 75B

IMPULSE RESPONSES OF THE NON-CENTER-INTERVAL INTERPOLATION FILTER AFTER OPTIMIZATION

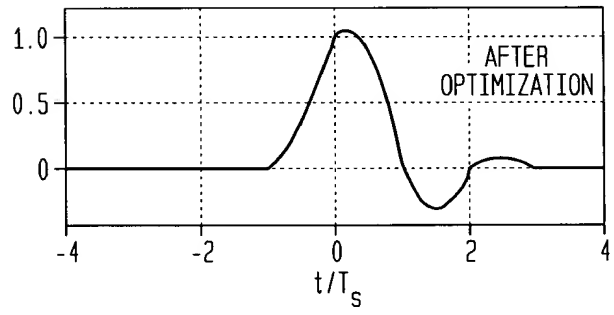

FIG. 76A

FREQUENCY RESPONSES OF THE NON-CENTER-INTERVAL INTERPOLATOR BEFORE OPTIMIZATION

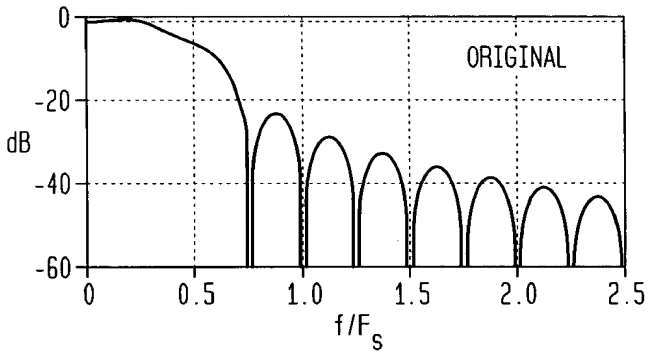

FIG. 76B

FREQUENCY RESPONSES OF THE NON-CENTER-INTERVAL INTERPOLATOR AFTER OPTIMIZATION

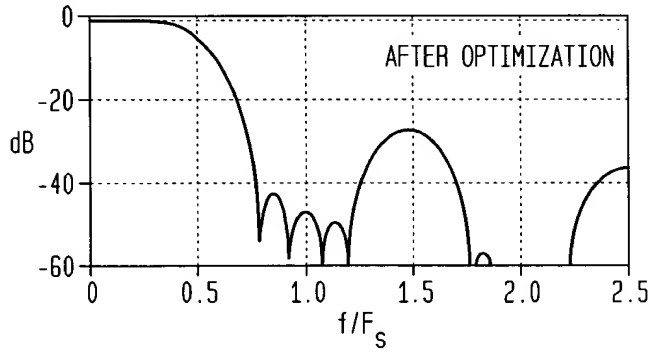

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FIG. 77

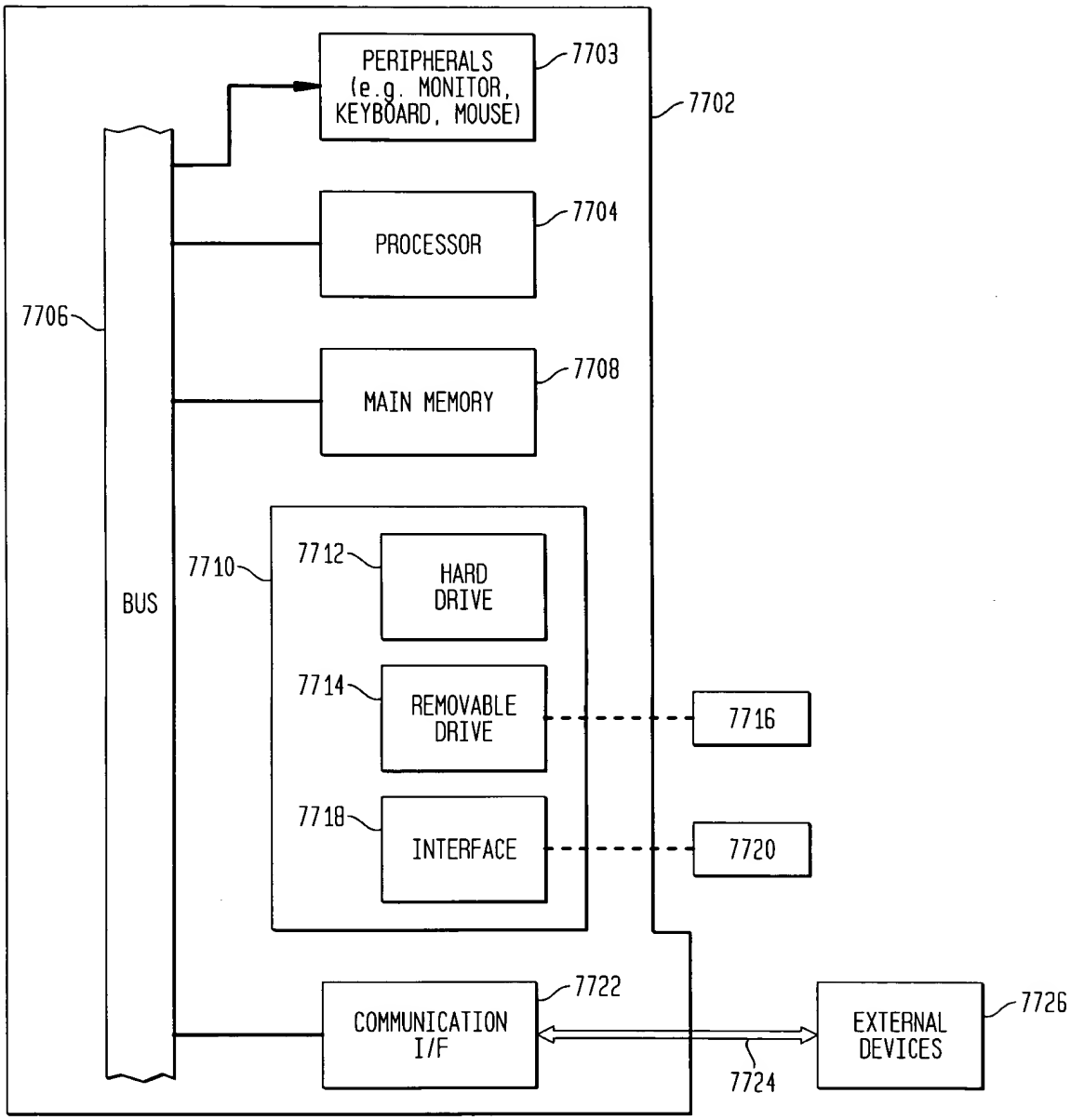
PERIPHERALS (e.g. MONITOR, KEYBOARD, MOUSE)
7703
7702
PROCESSOR
7704
7706
MAIN MEMORY
7708
BUS
7710
7712
HARD DRIVE
7714
REMOVABLE DRIVE
7716
7718
INTERFACE
7720
COMMUNICATION I/F
7722
EXTERNAL DEVICES
7726
7724

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FIG. 78
DATA RATE EXPANSION CIRCUIT